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JANUARY 1935

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AMERICA GOES DIESEL

Among Our Writers

W. A. Reeve was at one time a lecturer on engineering at London University. He has had wide experience in Europe in the construction of bridges and tramways and in the manufacture of wire rope. He has also designed, erected, and operated a number of concrete, steel, and suspension bridges and aerial rope tramways for both passenger and freight service for the Columbian Government.

Arthur F. Perry, Jr., after his graduation from Cornell University in 1916, went to Chile for the Braden Copper Company. There he had charge of surveys of canals and hydro-electric plants. After service with the A.E.F. in the Coast Artillery, he became superintendent of construction for the Texas Company at Port Arthur, Tex., on refinery work. Since 1920 he has been a general contractor in Jacksonville, Fla., on bridge and building construction.

Hunter Rouse, since his graduation from the Massachusetts Institute of Technology in 1929, has devoted his time principally to the study of overflow weirs. His thesis at Karlsruhe, Germany, under Th. Rehbock, was on "The Distribution of Hydraulic Energy in the Free Overfall." At Massachusetts Institute of Technology, on his return from Europe, Dr. Rouse assisted Prof. W. Spannhake, then visiting professor from Karlsruhe, on his work in applied hydrodynamics.

Lincoln Reid, following graduation from Massachusetts Institute of Technology in 1929, was engaged on hydro-electric work in New England. Returning to his alma mater, during 1932–1933 he studied and wrote the thesis, required for the master's degree, on which the article in this issue is based. During the school years 1933–1934 he was a research associate in civil engineering at Columbia University. Since July 1934 he has been in Denver, Colo., with the U. S. Bureau of Reclamation.

Elwyn E. Seelye, a graduate of Cornell University with the class of 1904, was engaged in an executive capacity in the design of the Grand Central Terminal in New York, N.Y., from 1909 to 1911. Since 1912 he has maintained an engineering office in that city. His firm has been responsible for the design of numerous notable buildings there and in Washington, D.C. He is the author of articles on such subjects as relative costs, concrete, structural steel, foundations, and welding.

Raymond P. Pennoyer really needs no introduction to the readers of Civil Engineering, having appeared before this audience on three previous occasions—November 1933, and April and June 1934. He continues to specialize in the safe design of structures requiring the use of steel sheet piling. His twenty years of experience in this field permit him to speak with authority.

George Hockensmith began his construction experience as a water boy when he was only 10 years old, receiving his engineering education at night school. After he had done varied construction work on railroad and bridge projects in the West, the World War placed him in charge of a lighter-than-air training field for naval officers. Since the War he has been construction engineer or superintendent on a large number of projects, including the Arlington Memorial Bridge; the Westinghouse Bridge; the Ridge Road Bridge; and the Albany-Rensselaer Bridge. At present he is in charge, for his company, of the construction of the Montgomery Island Dam.

Charles P. Berkey has recently acted in a consulting capacity on the geological features of Boulder Dam, San Gabriel Dam, Morris Dam, and Bouquet Canyon Dam. At present he is consulting geologist on the Swift-Wachusetts (Boston) water supply project; for the Port of New York Authority on its bridge and tunnel projects; and for the U. S. War Department, the U. S. Bureau of Reclamation, and the Tennessee Valley Authority on their many dam projects in the United States.

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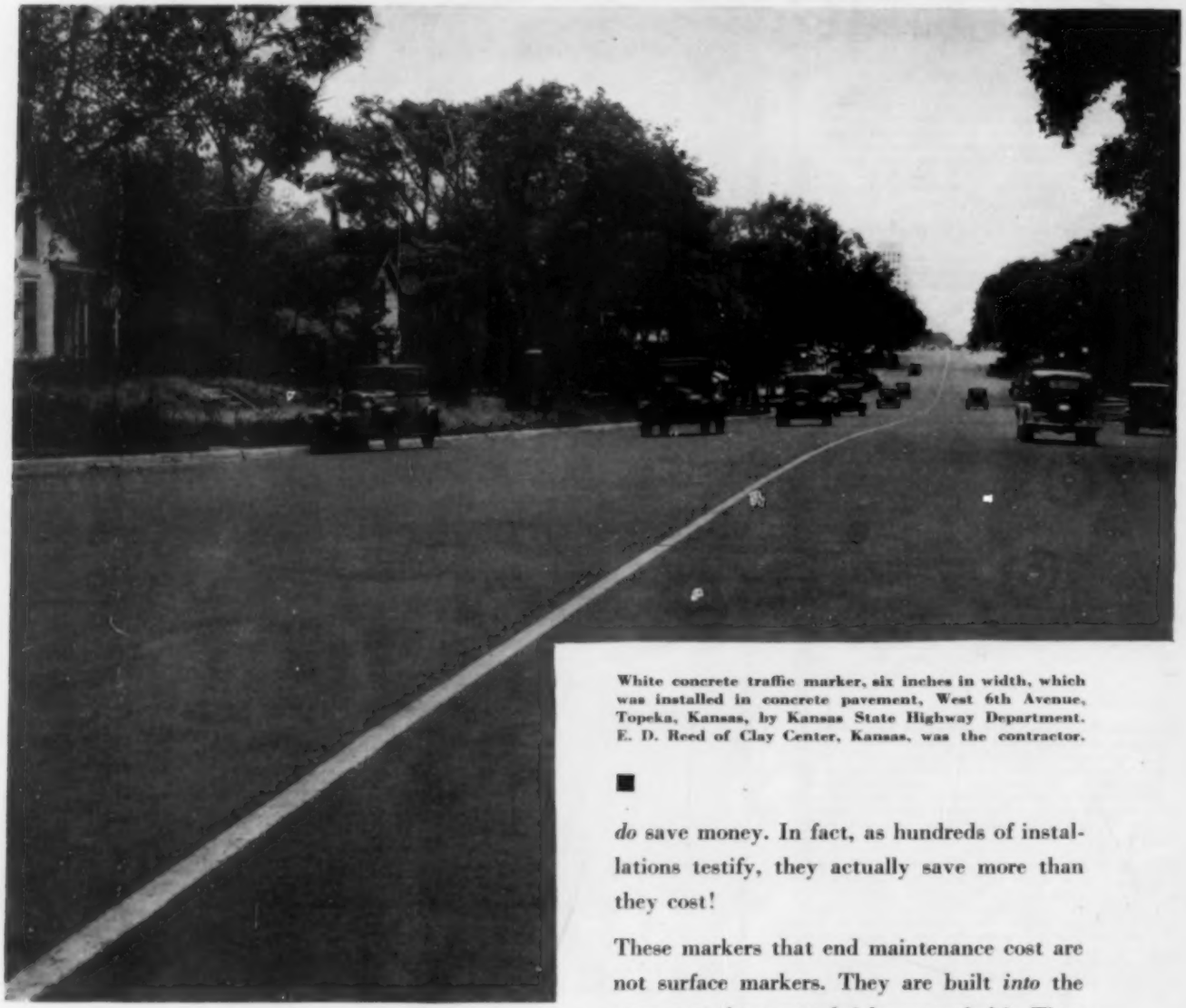

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VOLUME 5 NUMBER 1

Speedy Erection of a Suspension Bridge

Pre-Stressed Cable Strands Fabricated in the United States Expedited Construction of Ramfis Bridge in the Dominican Republic

By W. A. REEVE

MANAGER OF ERECTION AND RESIDENT ENGINEER, FOR JOHN A. ROEBLING'S SONS COMPANY, OF TRENTON, N.J.

SOME unusual features marked the design of the Ramfis Bridge. Among them were the use of pre-stressed strands in the cables, each of which was cut to length in the shop; a light-weight floor of interlocking steel channels filled and faced with pre-cast asphalt planks; and open-strand cables of galvanized wire, a type of construction which facilitates access for inspection, painting, and maintenance. Remarkable speed of erection was made possible by this simplified design. Because of the accuracy with which the cables had been measured and marked during pre-stressing at the factory, each cable strand was erected in place without the necessity of field measurements, the two cables being completed and adjusted in eight days. As a record of the rapid erection of a short-span highway suspension bridge located in the West Indies, 2,000 miles from the fabricating shop, Mr. Reeve's article is of more than usual interest. The time required from the beginning of the design to the completion of the structure was five months.

FOLLOWING the completion of the San Rafael Bridge over the Rio Yaqui del Norte, near Mao, in the Dominican Republic, work was commenced on the design of the Ramfis Bridge over the Higuamo River, near San Pedro de Macoris. This bridge, which is about 43 miles east of the city of Santo Domingo, the capital of the Republic, links the entire eastern part of the country with the capital city. For many years a gasoline-powered, paddle-wheel ferry had been in service at the crossing, which is on the principal arterial highway of the Republic. Since the river here is tidal and is 26 ft deep for 300 ft of its width, it can readily be seen why there has been a demand for a bridge at this point for years.

The bridge consists of a central suspended span of 554 ft and two suspended side spans of 186 ft each, the total span of cables from anchorage to anchorage being 1,044 ft. From end to end of the approach handrail—that is, over the extremes of the anchorage blocks—the total length is 1,103 ft. The clear height from the bottom of the bridge to the water is 70 ft; the height of the steel part of the towers, 120 ft; and the width of the roadway, 20 ft.

DESIGN OF SPAN

The design was based on the standard, first-class United States highway loading, H-15, and in addition provision was made to withstand tropical hurricanes, which in this locality sometimes reach a velocity of nearly 200 miles per hr. In 1930 a velocity of 185 miles per hr was officially recorded on an airport anemometer near the site of construction. At this velocity the instrument blew away from its moorings, so that although the wind increased in intensity, later velocities could not be recorded. Strong battened channel diagonals placed below the deck at the lower chord elevation provided resistance to wind load. The value of the welded steel interlocking floor as a wind brace is considerable, but in order to ensure an additional margin of safety this added strength was not considered in the design.

Each tower consists of two posts—a square box section built up of plates and corner angles—connected with horizontal struts and V-shaped bracing. Countersunk saddles are set into the tops of the tower columns and protected against the weather by covers. The bearing for the lowest layer of cable strands in each saddle is a grooved steel casting; and that for the middle and upper layers, steel reinforced zinc filler blocks. Each of the two cables consists of nine galvanized steel bridge strands, each strand being $1^{9}/_{16}$ in. in diameter. Pure zinc buttons cast on each strand, fore and aft of the saddles, serve for shimming and locking the cables to the tower tops.

Each strand was pre-stressed, measured to exact length while under working tension, cut to length, and marked at the factory before shipment, so that in the field the marks corresponding to saddle centers could be set to the center mark on the saddles as soon as the cables were hoisted. These marks proved so accurate that, when the strand sags were adjusted to the correct elevation, a variation of only $^{3}/_{8}$ in. was noticed.

Similarly, the marks for the positions of the cable-bands to which the suspenders are attached, proved to be accurate in every case, so that it was necessary merely to set the bands at these marks and to tighten the bolts. The advantage of this accuracy, which is obtained by pre-stressed measurement in the factory, is such that the strands can be treated in the field as accurately fabricated pieces of steel work and dropped into place without the necessity for any field measurements. The cables are of open construction, each

strand being so separated that it will be easy to inspect and paint all surfaces at any time after the bridge is in service.

The cable anchorages are of a special type, consisting

PADDLE-WHEEL FERRY REPLACED BY BRIDGE AT SAN PEDRO DE MACORIS

of bearing blocks and adjustment shims. Most of the suspenders are made of cable strand, also pre-stressed and measured to exact loaded length in the factory. The five short suspenders at the middle of the main span on each cable consist of double steel links. All the suspenders are pinned to the reinforced webs of the truss posts just inside the top chord. The cable bands, of a new and improved type, illustrated in an accompanying photograph, consist of four vertical grooved plate castings bolted together with four steel bolts. The suspenders are attached to a steel pin passing through the cable band.

The trusses are divided into 15-ft panels, each consisting of vertical posts at the suspender points and two diagonals meeting at the center point of the top chord. At each tower, the trusses rest on vertical rocker links to provide for deflections and temperature changes. Near each cable anchorage at the end of the side-span truss the cable is held down by a rocker or articulated post anchored to the small concrete pier on which the stiffening truss rests.

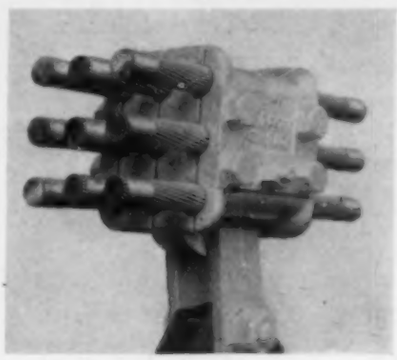
PROGRESS OF ERECTION RAPID

From November 4 to 18, 1933, a small gang was occupied in clearing the site of jungle vegetation; building the engineer's house and office, and stores for cement and tools; bringing the 33,000-v power line to the site; and gathering together equipment from various parts of the island. As the river water is saline and highly corrosive, a well 6 in. in diameter and 100 ft deep was driven and equipped with an electric deep-well pump. From this well a 2-in. pipe line was run to a battery of tanks, with a capacity of 6,000 gal, on a 20-ft timber tower, and thence across the bed of the river to a similar set of tanks on the far side of the river. The pipe line across the river was suspended by floats at several points to keep it from drifting away or sinking into the 100-ft stratum of soft mud in the river bottom. These floats were provided with port and starboard navigation lights.

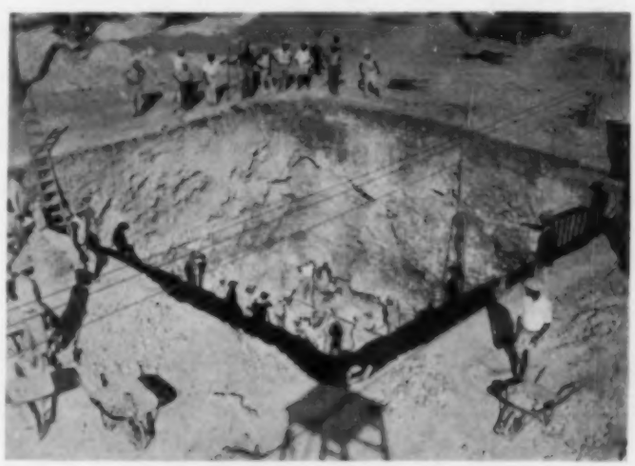
For the camp a rain-water catch provided water for drinking and bathing and supplied the kitchen. A local sewage-disposal system was installed, with toilets supplied by well water. Barracks for the workmen were then built, and the whole site was enclosed in barbed wire. There were four entrances to this enclosure with guards at each. Access roads, totaling over a mile in length, were opened and graded at both ends of the bridge. This work was done by hand labor. The next two weeks were spent in making a survey, borings, and soil pressure tests and in locating the reference stakes and bench mark references.

LOCATION AND MEASUREMENT OF SPANS

On the transverse center lines of the towers, base lines equal to the main span of the birdge were run out from each side of each tower, and earth platforms were placed with a location stake in each. In one case this platform was a wooden jetty on piles in the river. This gave a 45-deg angle for triangulating the main span. As a check triangulation, a similar set of platforms was established on the same bases to provide a 30-deg angle to the opposite shore. Then the exact span of the bridge was staked on a level stretch of highway, a 10-ft post erected at each end, and a 600-ft length of aircraft cord $^1/_8$ in. in diameter anchored at one end. The chord was passed over ball-bearing sheaves on the tops of the posts and counterweighted with a 600-lb weight at the far end. By means of plumb bobs the staked distance of the main span on the ground, 554 ft, was transferred to the high-tensile steel aircraft cord and marked by white paint and friction tape. The counterweight and cord were then passed across the river over the main-span location stakes and checked 20 times. The average showed the triangulation marks to be $^3/_4$ in. longer than the direct measurement given by the aircraft cord, so the marks were closed in to suit. The triangulation stakes, which were of hardwood 9 in. in diameter with $^1/_{16}$-in. pins for marks, were set in concrete 2 ft deep. The measurements from tower footing to cable anchorage were made in three ways, and checked 20 times for each method. The first method employed a plumb bob and tape and horizontal steps of 10 ft; in the second method measurements were made by means of vertical



CABLE-BAND CLAMP FOR ATTACHMENT OF SUSPENDERS



EXCAVATING FOR A TOWER FOUNDATION

angles and inclined tapes read with the theodolite; and the third method was by vertical ordinates and inclined tapes, with a precision level reading. The results of these three methods were averaged.

REINFORCED CONCRETE ANCHORAGES

Excavations for the towers and anchorages were made in calcareous rock, which required blasting. The only equipment used consisted of picks and shovels; 18-ft lengths of hexagonal drill steel with flat points; two compressed-air concrete breakers with either star or

POURING THE PIER FOR A TOWER

triangular points; and stepped platforms for throwing up spoil.

The presence of water in the pier holes excavated for the towers necessitated the use of two 4-in. and three 6-in. centrifugal pumps with choke discharges. For four of these pumps an electric motor drive was devised, and the fifth was driven by an old Ford automobile engine. On completion of the pier holes, borings were made to a depth of 14 ft below the rock floor of the holes to test for cavities or change of strata. Furthermore, the rock surface line was traced by borings for a considerable distance riverward, thus establishing the rock profile and eliminating all danger of future scouring or washouts. All this work was completed by January 22, 1934, on the Santo Domingo side, and by January 30 on the San Pedro de Macoris side.

Pouring of the concrete for the tower piers commenced January 27, and the Santo Domingo pier was finished on January 31. The forms and reinforcing steel had been prepared in advance, the forms being in bolted sections for use on both sides of the river consecutively. Great care was taken in pouring the concrete to the exact elevation required so that no chipping, grouting, or shimming were necessary under the tower footings.

A week after the second pier was concreted, the Santo Domingo anchorage was poured. The process required from February 17 to 21, the anchor steel having been

STARTING ERECTION OF A STEEL TOWER

PRE-STRESSED CABLE STRANDS BEING ERECTED

placed in advance on concrete stools. The main block of the San Pedro de Macoris anchorage—about 1,000 cu yd—was poured in one piece by mixing and placing continuously for four days and three nights. No construction joint was necessary.

ERECTION OF TOWERS

On March 5, on the arrival of some of the tower steel, erection was commenced. A 55-ft, 12 by 12-in. gin pole was used to put the 10-ton column footings in place, and the same gin pole was used to set the 87-ft, 13 by 13-in. gin poles on the piers, two on each pier, with four guys to each. These gin poles were made by splicing a 67-ft pole to a 20-ft pole. Thereafter, for the top members of the tower, a 55-ft pole was used. The 87-ft composite poles were placed on top of the shorter poles, and the whole moved out from the tower columns, lashed to the tower, and guyed at the top. The hoisting rig consisted of a 4:1 $^{5}/_{8}$-in. plow-steel wire rope running through a snatch block attached to one drum of a pair of 2-drum, 50-hp electric hoists. Owing to the severity of the weather during the month of February, the shipments of tower steel were somewhat delayed. As a result, erection of the towers had to take place spasmodically, as steel came in, over a period extending from February 25 to March 18.

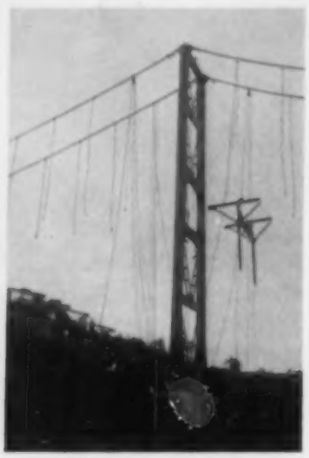
All steel shipments were brought up the river on lighters from the port of San Pedro de Macoris and deposited on two homemade floating wharves by means of two timber derricks. These derricks were fabricated at the bridge site, the fittings being hand forged and the timbers hand dressed by bridge-erection gangs, composed entirely of Dominicans. After the tower steel had been erected, it was riveted, and assembly of the truss panels was commenced on the ground below.

ERECTING CABLES AND ATTACHING SUSPENDERS TO THEM

The next step was to place the reels of bridge strand in order at each end of the bridge anchorages and to set up four timber horses with hollow shafts to take the reels. In the meantime two lengths of flexible wire rope, $^{5}/_{8}$ in. in diameter, were spliced together to give one piece 3,500 ft long. One end of this was fastened to a drum of a 50-hp winch at anchorage *B*, the other end was passed across the river and through snatch blocks around anchorage *A*, back across the river,

around anchorage *B*, and was fastened to the second drum of the same winch. About 1,300 ft of the $^5/_8$-in. line was reeled in on this drum, leaving the sag of the going and coming lines just below the surface of the water. A pennant was attached to the south line at anchorage *B* and another to the north line at anchorage *A*. Simultaneously, a bridge strand socket at end *B* and one at end *A* were fastened to the pennants and two strands were hauled out together, one going east and

ERECTION OF TOWER STEEL WITH WOODEN GIN POLES



LIFTING THE FLOOR SYSTEM INTO PLACE

the other west. On arrival, the front sockets were fixed in their anchorages, and the rear sockets taken from the reels and fixed in their anchorages.

During the operation of hauling the strands a slight back tension was maintained by snubbing the reels with a piece of timber. A whip was then lowered from the tower top and the tower-top part of the strands was picked up by a two-hook equalizing sling, so that both strands could be hoisted simultaneously to the tower tops. This operation was repeated until the first layer of six strands—three in each cable—was in the tower saddles. Adjustment of the strands then began by shimming the strand buttons at the tower tops in order to give correct elevation of the strands at the middle of the main span. This was checked by transit and precision level, the towers having been checked previously for verticality of center line.

After the strands were locked at the tower top, each strand in turn was pulled back at the anchorage and shimmed there. This had the effect of bending back the tower tops a few inches away from the river. The new elevation at the middle of both the main and side spans was then checked, and the saddle fillers were placed in the tower tops ready for the next layer. After a second layer had been hauled and hoisted, it was shimmed and locked at the tower top in order to bring it parallel to the lower layer. It was then pulled back and shimmed at the anchorage so as to bend the tower top back a little more. The new sag elevations were checked in both main and side spans, and the same operation was repeated for the third and last layer.

The anchor post in front of each anchorage was then clamped to the cable and the cable pulled down to position by the anchor bolts in the small pier on which the stiffening truss rested.

After the resulting sag elevations were checked, the cable bands and suspenders were assembled on the cables at the tower tops and each assembly was slid down to its mark on the cable by a man seated astride the cable, who tightened the cable band bolts after he had arrived at the proper position.

PLACING TRUSS STEEL AND FLOOR

At this point endless $^5/_8$-in. wire rope grommets were placed in pairs fore and aft of the eight cable bands nearest to the towers, and a four-to-one wire-rope block and tackle was hooked on at eight cable bands simultaneously. On the ground below the towers, each floor beam was riveted to its two truss posts, and two top chord sections with four diagonals were bolted to the truss-post gusset plates. Then the two corresponding bottom chords were fastened on by means of single bolts acting as trunnions, so that when they were in the air they hung down vertically, supported at one end. After this operation was completed, two grommets were passed around each end of the floor beam inside the truss posts, the hoisting tackle being restrained by passing through an 18-in. U-bolt fixed in the top of the truss post. Thus a complete truss panel of 15 ft with its floor beam formed one lift. Four panels were hoisted simultaneously and pin-connected to the suspenders, 19 panels being hoisted and placed in 8 hrs. The whole truss and all floor beams were hoisted, placed, and connected in $4^1/_2$ days, the work proceeding outwards from the towers each way. A check was kept on the positions of the tower tops at all times to prevent undue motion and possible slippage of strands through the saddles.

Wind bracing and stringers were hoisted on a whip and placed outwards from the towers. Then two-thirds of the floor plates, which are of the interlocking channel type, were hoisted and placed in pairs on each panel of the floor stringers. Previously the under sides of the plates had been painted with aluminum. By the time the plates were placed, the cables had sagged to the curve which made it possible to bolt up all chord splices and diagonals without having to force a single connection. In fact the closing splice overlapped $^1/_8$-in., until it was noticed that a heavy timber was resting on the cables above the splice. After this timber was removed, the splice slid into place by hand pressure. Meantime the towers had been coated with aluminum paint inside and out. The floor beams and below-

STIFFENING TRUSSES READY TO BE CONNECTED

deck wind bracing were also painted at this time to avoid the use of scaffolding later.

Next, 20 gangs were put to work riveting the lower chords, the wind bracing, and the stringers. After this was done, the rest of the floor plates were placed and welded.

The operation of placing the floor consisted of inter-

locking each section of floor plate. The sections were about 5 ft wide by 20 ft long, that is, the width of the bridge. The 5-ft sections were hooked together by engaging the channel flanges, and two hardwood spacers were hammered into the joint. Then the last plate engaged was centered between the two adjacent truss posts by hardwood shims. Immediately after this operation, a gang laid a timber measuring 10 by 10 in. by 21 ft across the deck and, by means of a jack placed under each chord, forced the deck plate down on top of the stringers. The welder then filled the plug welds over each stringer and tack-welded the engaged flange splices. This operation was started on both sides of each tower simultaneously and progressed until finished.

Every groove in the deck plates was filled with pre-cast asphalt planks and rolled with a 12-ton road roller. Just before each filler was placed, the grooves were coated with cold asphalt cement by means of brooms

PRE-CAST ASPHALT PLANKS LAID IN FLOOR GROOVES

and 6-in. flat brushes. Mineral-surfaced asphalt slabs were laid longitudinally with staggered joints over an additional coating of cold asphalt cement. After the full dead load was in place, the top chord was riveted. The road roller again passed over the finished road surface for several hours. Wheel guards were placed and bolted with lock nuts to facilitate repairs in case of traffic damage.

After the cable bands had been given their third and final tightening, the painters completed the first and second coats of paint. A white center line and traffic arrows were then painted on the deck.

APPROACHES AND DRAINAGE

In the meantime the highway grading had been extended to the anchorages, the sand compartments between the anchorages and the truss-rest piers had been filled, and the tar top surface rolled into the approaches. A steel handrail was then placed between the anchorage pin and the truss rest piers to protect the cables, and a well-designed concrete balustrade was poured and faced on top of the anchor blocks. Each balustrade terminated in an artistic obelisk carrying an opal globe light at its summit. A short section of the highway proper was then fenced with a dwarf mortarless stone wall, pointed with cement and topped with a reinforced concrete coping.

To facilitate the escape of rain water from the cable, a concrete collecting trap was poured against each side of the buried anchor block, and a 4-in. earthenware drain pipe 200 ft long was carried down the hillside away from the bridge site. Since the Santo Domingo anchorage is underground, it was provided with concrete inspection vaults for the cable connections and a pair of padlocked manhole covers. The San Pedro de Macoris anchorage, which is above ground level, was provided with reinforced concrete inspection chambers and padlocked steel doors.

SHORT CONSTRUCTION PERIOD

As a result of the severe winter and two months of tropical rainy season, which caused delays in the shipping

CONCRETE BALUSTRADE OVER THE ANCHORAGES

of materials, certain phases of the original estimated schedule of construction were lengthened. However, such delays were offset later by a speeding up of the final stages of the work to such an extent that the bridge was finished by May 5—six weeks ahead of the contract date, June 15.

When it is realized that the Ramfis Bridge was designed, fabricated, shipped 2,000 miles by sea, and erected complete in the short space of five months, in spite of adverse winter conditions affecting fabrication, shipment, and construction at the site, the economic value of such modern suspension bridges is readily apparent. Making excavation for tower piers, anchorages, and rest piers occupied only 11 weeks. Placing the concrete, which was mostly reinforced, required 16 days. Erection of the tower steel occupied 13 days, including waits for shipments, while erection and adjustment of the cables were accomplished in the remarkably short time of 8 days. Hoisting and placing of the complete trusses and floor beams required but $4^1/_2$ days, and only 5 days were spent in placing and finishing the asphalt floor. The towers, superstructure steel, cables, and floor were erected complete in 55 working days.

The interlocking type of steel floor used in this bridge, quite apart from the economy of its light-weight design and the reduction of dead weight in the structure, proved very convenient as a loading medium for no-stress splicing of the truss chords and as a working platform for the riveters. Another feature of importance is the fact that the moment the last piece of mineral-surfaced asphalt roadway material was in place, road rollers and vehicular traffic could be allowed to pass over the bridge. General Trujillo, the President of the Republic, opened the bridge on May 18, and the fiesta in celebration of the event lasted three days and nights.

For this bridge the design of the concrete substructure and the steel superstructure, together with the furnishing of all steel and cables, was in charge of the John A. Roebling's Sons Company under direct contract with the government of the Dominican Republic, for whom A. W. Rogers, Assoc. M. Am. Soc. C.E., is consulting engineer. I served as resident engineer for the company.

Engineers in Administration of Florida Relief

A Resume of CWA and FERA Activities in the State

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IN the recent country-wide program of relief which was conducted through various forms of administration, the peak was reached during the CWA administration. During this period, which lasted about three and one-half months in Florida, more than 4,000,000 needy persons were employed in the whole country. This involved an outlay of approximately $750,000,000, most of which was used for payroll, Florida's share being over $15,500,000. In this article Mr. Perry gives an interesting résumé of the administration of relief activities in the state of Florida, emphasizing particularly the work of the engineer in this connection.

IN order better to understand the engineering problems involved in the Civil Works Administration and the Federal Emergency Relief Administration, it is well to consider the aims underlying the establishment of these organizations. In the final analysis the success of the program should be judged by the extent to which these aims were fulfilled. Since the creation of both administrations was an emergency measure in a time of acute distress, there were many flaws in their organization which doubtless would have been avoided if there had been time for deliberation. This statement holds true for the engineering department as well as for the entire organization.

The fundamental purpose of these administrations was to provide employment for persons who needed it. It was a case of putting a man to work at the first job that came to hand and as quickly as possible. Later when the engineering department began to function more smoothly, an effort was made to place men on jobs for which they were best qualified. The work as a whole throughout the state of Florida was carried on by employees who were listed on relief rolls. The general type of man on these rolls is below the average in ability in the various trades and is not the sort of person one would hire on a contract job. I estimate the efficiency of relief client workers as a whole to be as low as 50 per cent of normal.

EMERGENCY RELIEF ACT OF 1932

In its present form the FERA is a continuation of three, more or less similar, administrative acts passed to provide relief. Through provision of the Emergency Act, which was passed in July 1932, funds were loaned by the Reconstruction Finance Corporation to the various states. These funds were entrusted to the governors of the states who, with the aid of advisory councils on employment relief, were responsible for their administration. Florida received the first money from this fund in September 1932. The allotments were made to counties, the allotment for each county being administered by an especially appointed advisory council. The head of this county council, called an administrator, was chosen because of his standing in the community and served without compensation.

At state headquarters, at Tallahassee, an engineering department was set up. At first the duties of this department were merely to traverse the state, contact the various administrators, and attempt to provide some sort of a work program, whereby the recipients of money from this relief fund would be called upon to earn it. The general type of project set up at that time consisted of cutting weeds, raking leaves, and making community gardens. Although during this period $3,900,000 was spent in Florida, the engineers employed, of whom there were only three or four in the entire state, received salaries of approximately one hundred dollars a month.

As a result of the "new deal," inaugurated in 1933, the Federal Government came to the aid of the various states. On May 12 the Federal Emergency Relief Act was passed, and an added impetus was given to relief work. From then on the work fell into two classes, namely, investigation of applications for relief and providing work relief for approved applicants. By November the relief case rolls in Florida represented nearly 30 per cent of the total population of the state.

The class of work, as heretofore, was of a purely maintenance nature, the permanent value of which was generally negligible. Finally, however, a number of projects were originated throughout the state by local governmental units. Materials were donated for these projects, which have proved very worth while.

The engineering department was permitted to increase the force of active field engineers to five. It was the duty of this department to suggest projects of a more worth-while character. They endeavored also to have placed in each local county administrative unit a man of technical training who was termed the "director of work." He was made responsible for the projects in his section and handled everything, from getting up projects to acting as foreman, supervisor, timekeeper, and paymaster.

It can readily be seen that at this time, in the development of the relief programs, there was no engineering department or supervision worthy of the name. Then the program expanded so suddenly that the department had to operate under the tremendous handicap of lack of preparation.

SWIMMING POOL AND BATH HOUSE, DELRAY BEACH, FLORIDA
A Project of the CWA and FERA, Completed in November 1934

The purpose of the CWA was to provide work for legitimate relief cases and to overcome the stigma generally attached to the receiving of direct relief. In Florida the CWA was formed in accordance with Government instructions and operated under Government rules and regulations. On November 22, 1933, CWA offices were established in Tallahasse by simply increasing existing FERA personnel in order to care for the greater volume of work. It was originally intended to close out the CWA program on February 15, 1934. Actually it ran from November 27, 1933, to March 10, 1934, or a total of 15 weeks and 2 days.

Due to the suddenness with which the program was launched there was little time for preparation. All county relief administrators, of whom there was one for each of the 67 counties, were informed by wire that they were to become administrators in their respective counties of the CWA program and that they should transfer all their relief cases to the CWA. On the first day of operation, 42,000 were thus transferred from the FERA to the CWA. At the close of the fourth day 62,000 had been transferred, and by the end of the first month 92 per cent of the relief cases were employed by the CWA. Thus within 30 days employment on several thousand approved projects had been found for some 85,000 men. In comparison with other states, Florida ranked high for the speed with which projects were provided and men put to work.

RECREATION BUILDING ON EXPOSITION GROUNDS
Sunshine Park, Orlando, Fla.

A CONVICT CAMP IN ORANGE COUNTY, FLORIDA
Project Is Located Southwest of Orlando

The state administrator allowed most old FERA projects to continue under the CWA with the provision that they must be regularly submitted and officially approved as soon as possible. New projects were checked by the engineering department at such a rapid rate that an engineer often passed on as many as 35 in one day. Fully 90 per cent of all CWA projects were approved during the first two weeks. In round numbers this amounted to over 4,000 projects. Blueprints and specifications were conspicuous by their absence. The engineering department had little time for anything during this period but checking extensions. In the rush of approving applications a number of projects that had been turned down by the engineering department were later approved by the executive board, whose authority was final.

At first no limitation was set on the number of projects that could be submitted by any county. However, the counties were limited in the number of CWA employees by their man-hour quota. In most instances they had secured approval of far more projects than they could possibly hope to complete within the allotted time. Then, too, political influences promoted work on certain projects at the expense of others, with the result that at the end of the official CWA program on March 10 there remained a large number of incomplete projects.

As the CWA program progressed, the engineering department requested the counties to resubmit a list of preferred projects from among the original ones that had been approved, so that a second and final list could be made up. It was hoped in this way to eliminate a great number of worthless projects that had been passed upon in the first mad rush of enthusiasm. However, this method did not give the desired results, because numerous pieces of work that had already been started throughout the state could not conscientiously be stopped. Consequently, on March 10 it was estimated that approximately eight million dollars would be required to finish the projects originally authorized.

During the working out of the CWA program the engineering organization consisted of a state engineer and an assistant state engineer. There were also six district engineers and eight office engineers, all of whom had headquarters in Tallahassee. The district engineers, who had control of the work in their respective localities, had the privilege of employing as many inspectors as was deemed necessary to supervise the active projects in their districts. These inspectors made daily visits to the projects and kept the district engineers informed of the progress of the work by means of reports. The district engineers in turn reported weekly to state headquarters. In this way the headquarters could keep track of the work throughout the state and make many technical recommendations.

After the first few weeks of work an attempt was made to keep the program within reasonable limits by making it necessary to have the district engineer approve all projects. It was, however, a case of locking the barn door after the horse had been stolen. During the 15-week period of the program a total of nearly $16,850,000 was spent in the state. Of this amount, 92.3 per cent

was furnished from Federal funds and the remainder from various local contributions.

Expenditures were made at the rate of $1,100,000 per week. Records show that nearly 95 per cent of this huge sum was spent directly on work projects. Of the remainder, 4½ per cent was devoted to administrative costs; one-half of one per cent went into the maintenance of reemployment offices; and only three-hundredths of one per cent was used for compensation for injuries. This last is a significant factor. For nearly 100,000 work relief cases, payments for injury totaled slightly over $6,000!

Allotments were made by counties, Duval County being the recipient of $2,000,000, the largest amount received. The smallest allotment was made to Hendry County, whose total during this period was only slightly in excess of $20,000.

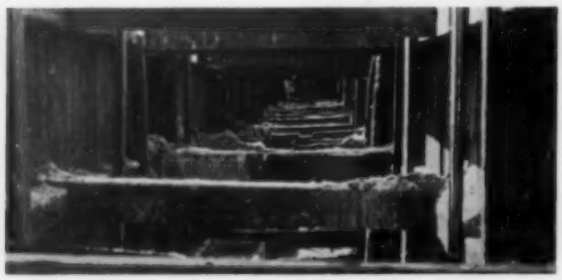
AIRPORT AT LAKELAND BUILT BY RELIEF LABOR
One of Florida's 118 Usable Airports, as of January 1935

The largest approved CWA project in the entire state was the Tampa Fair Grounds. This project was approved for $367,000, of which amount $257,000 was actually spent prior to March 10. Since the inception of the present FERA program this project has been completed for much less than the original estimate. A park beautification project, calling for an expenditure of $750,000, was submitted only a few weeks prior to the close of the CWA program. Needless to say, it was not approved.

Some of the outstanding projects started under the auspices of the CWA were the Tampa Fair Grounds, the Ravine Gardens at Palatka, a large mosquito control project at Miami, a sanitary sewerage system for Jacksonville, the Welaka fish hatchery, and a consolidated school building at Jay. This latter project, which involved an expenditure of slightly over $100,000, called for the construction of one of the largest rural schools in the state. The original building was destroyed by fire early in November 1933 and, because of the financial condition of the county, it was impossible to rebuild it. Except for the aid of CWA funds, a number of pupils would have been without schooling for some time. Most of the projects just mentioned were not finished at the close of the CWA program, and the completion of these under the present administration, which is limited to relief, has become one of the many problems of the engineering department.

The present program of relief was authorized by the Federal Emergency Act of 1934. This program differs radically from the CWA program which it succeeded in that it sponsors relief through work projects requiring a minimum expenditure for materials. The program also inclines toward the work of rehabilitation, and the projects therefore are becoming increasingly less constructive in nature. This of course is not the sort of a program that engineers like to develop. Furthermore, unless the civil agencies interested will provide the necessary materials, it will be almost impossible to do any work of a permanent engineering nature.

Moving the headquarters for the entire state from Tallahassee to Jacksonville, where it could operate more efficiently, was the first step in the new program. Besides the lack of money for materials, we were handicapped further in developing this program by the fact that there was a budgetary allowance for relief and that the amount allotted to Florida for this purpose was very small. A common laborer could work on an



NORTH SHORE SEWER EXTENSION, ST. PETERSBURG, FLA., BUILT BY RELIEF LABOR
At Left, Ground-Water Lowered by Well Points for 36 and 48-In. Lines;
At Right, Sheating, Cribbing, and Shoring for 36-In. Sewer

MIRAMAR SEA WALL
For Protection of Shore Along Biscayune Bay

average of only three days a month, and the maximum for skilled labor became from one to two days. By budgetary allowance is meant the minimum amount of money per month certified by a case worker as the least that a given family could subsist on. Soon after the organization was set up in Jacksonville the office force of the engineering department was reduced approximately 50 per cent, all of our 80 field inspectors being let out at that time.

A unique administrative control was then established in the state. Under this Florida was divided into ten regions. The present engineering organization is headed by a technical advisor, who is on the state administrator's staff. The engineering department consists of a chief engineer and four technical assistants, including a field engineer, a project engineer, an architect, and an estimator. These men have had experience in road construction, drainage, sewerage, and other public utilities work as well as in general building construction. Airport construction, mosquito control, recreation, and beautification projects, together with the public health work, are handled by special departments. However, the supervision of all these projects remains with the engineering department. Each region has an administrator, an engineer, an auditor, and a relief director. Generally, this same system was followed in the organization of the various counties, in which minor officials reported directly to their superior officer in the regional administration. The engineering representative in the county was termed a director of work.

It was found that in order to complete the CWA projects already begun it would be essential to have donations, and the additional duty of securing these

ONE OF FLORIDA'S NEW HIGH SCHOOLS
A FERA Project at Apalachicola

was placed on the field engineers, who cooperated very wholeheartedly. Except for school projects, the completion of which was taken out of the control of the regional engineers by state headquarters, there was hardly a project for which necessary donations for materials and skilled labor were not obtained by our regional engineers or their representatives. In one region alone over $100,000 was obtained entirely through the enterprise of the regional engineer. I estimate that approximately $750,000 has been obtained through the efforts of the engineering department.

On October 1 the ten regions were decreased to eight, although there is the same administrative personnel in these eight districts. The 67 counties have been proportioned among these districts, proper consideration having been given to such features as the number of relief cases, accessibility, and geographical location.

The 1934 relief program includes many and varied kinds of work. It is expected that there will be 13 beef-canning plants in the state. Construction has already been started on them, and at this time 11 canneries are operating. The average capacity per day will probably be 100 cattle per cannery, and the plants were designed to handle approximately 250,000 head. However, it appears that only about half of this capacity will be utilized. The program includes receiving cattle from the West, unloading them, and providing proper grazing land. The cattle are to be slaughtered and the carcasses properly refrigerated. When needed, they will be sent to the various canneries for

CIVIC CENTER AT BARTOW, FLA.
Construction of City Halls, Municipal Buildings, Hospitals, Schools, and Community Buildings Forms Part of Florida's Relief Program

processing, and all of the canned beef will be given to relief cases.

The construction of airports has received full support in Florida. This is an ideal type of relief project in that it can utilize a maximum of unskilled labor. The location of the state makes it suited for an extensive aviation development, especially when the subject of travel between North and South America is considered. Prior to the inception of the FERA program, there were 68 airports in the state, most of which were poorly marked and badly maintained. At best they could be classed only as emergency landing fields. By January 1, 1935, however, it is expected that 118 usable airports will be available. When the aviation program, as now contemplated, is completed, Florida will have 143 well-equipped fields. The vast expanse of lakes, ponds, swamps, and wooded areas in the state makes this contemplated development necessary to ensure the safety of air travel.

An extensive survey has been made of the number of farmers eligible for rehabilitation. Final estimates place the number of eligible farmers now on the land at 17,281. The aid actually extended to them will depend on the funds available for the development of the program of rehabilitation, which has broad possibilities.

Beautification and recreation work are in charge of special departments, which have representatives in the various district offices whose functions are largely promotional. However, once the projects are undertaken, they are handled by the work division just as is any other project.

Since March a special fund of $250,000 has been received for the completion of old CWA projects, the amount to be expended for the full-time employment of skilled labor, which was not available on the relief rolls. This fund, together with approximately $750,000 contributed by various counties and school boards, has brought the construction projects to a point where they will soon be completed. Engineers hope that, if a new work program is inaugurated in the winter of 1934–1935, it will take the form of a program of construction so that the activities of the FERA in Florida will leave worth-while monuments for the future.

Model Research on Spillway Crests

A Study of Pressure Distribution and of Discharge as a Function of Crest Design

By HUNTER ROUSE
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and LINCOLN REID
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FOR determining the profile of an overflow spillway, recourse has been had to the rule-of-thumb, but faulty, method of making it coincide with the free path of a thin jet of water discharging into the atmosphere with an initial horizontal velocity corresponding to two-thirds the expected head on the spillway crest. Actually, no single filament of the nappe can be found which corresponds with the assumed jet discharging freely under atmospheric pressure. A more reasonable and exact method is to make the profile agree with the under surface of the ventilated nappe of a sharp-crested weir at a corresponding head. Investigations made by Messrs. Rouse and Reid and by others throw new light on the behavior of such a spillway under the expected head as well as under appreciable overload. Although additional data at large scale are needed to obtain in dimensionless coordinates the shape of the ventilated nappe over a complete range of ratios of operating head to depth of approach flow, certain conclusions can now be drawn. The actual head may exceed the designed head on a properly shaped crest by a considerable amount without the likelihood of the sheet springing loose, despite the presence of negative pressures under the sheet. Of primary importance in causing separation is an abrupt or rapid change in the curve of the spillway profile. This dangerous condition can be avoided by giving careful attention to the curves, especially in the immediate vicinity of the crest.

IN the design of spillways, there are three essential requirements to be met: the maximum expected discharge must be passed with the least possible increase in elevation of the reservoir surface; the structure must be not only stable under all conditions but economical of construction as well; and the hydraulic characteristic of flow over the crest should be known more definitely than is now possible on the basis of unverified assumptions in design. It is questionable whether these three requirements can be met fully without a more accurate knowledge of discharge conditions than has been available in the past.

Research on the distribution of pressure and velocity in such curvilinear flow as occurs over various types of weir sections led Mr. Rouse to make an analytical investigation of the design of spillway crests. This investigation was conducted by him at the Massachusetts Institute of Technology, and presented in the form of a thesis for an advanced degree, entitled "The Distribution of Hydraulic Energy in Weir Flow with Relation to Spillway Design." Through this method of attack, a number of fundamental points became evident that apparently are often neglected or misunderstood in current practice. Conclusions reached in this investigation have been tested by Mr. Reid in the River Hydraulics Laboratory of the Massachusetts Institute of Technology by experiments with models. The results of his tests were presented as a thesis for an advanced degree under the title, "An Experimental Study of a Spillway Conforming to the Measured Lower Surface Nappe of Flow Over a Rectangular, Suppressed, Sharp-Crested Weir." Such definite substantiation was obtained by Mr. Reid that both analytical and experimental results are presented briefly here with the hope that they may be of value as well to those engaged in the design of hydraulic structures as to those interested in the interpretation of research with hydraulic models.

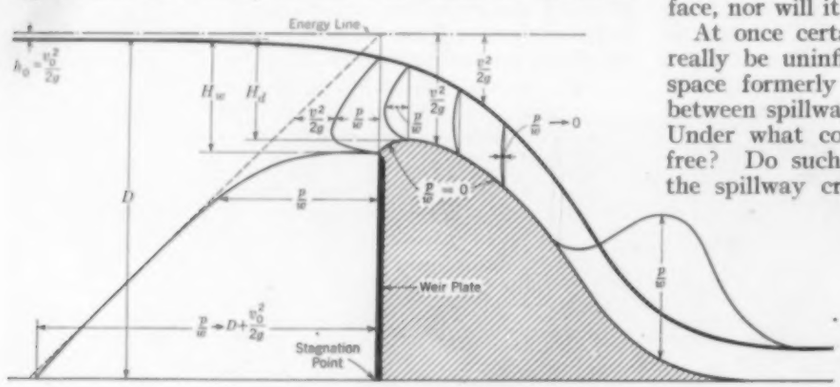

FIG. 1. SCHEMATIC VIEW OF SPILLWAY CONFORMING TO VENTILATED NAPPE OF A SHARP-CRESTED WEIR
Flow Profile and Expected Pressure Distribution

American engineers as a rule base the curve of the spillway crest on the profile of the fully ventilated nappe of water flowing over the sharp-crested weir. For example, in his book, *Engineering for Masonry Dams*, W. P. Creager, M. Am. Soc. C.E., gives a number of dimensionless curves based on measurements by Bazin. On the other hand, various purely empirical formulas are often assumed to give a fairly accurate idea of the trajectory of the undermost water particles from the moment they leave the top of the spillway. Such methods are founded on the belief that the presence of a solid structure below the nappe, and in immediate contact with it, will not appreciably affect the course of the freely falling particles of water; that is, neither will the nappe tend to spring loose from the spillway face, nor will it exert pressure on it.

At once certain questions arise. Will the discharge really be uninfluenced by a solid structure filling the space formerly occupied by air, and is the pressure between spillway face and nappe actually atmospheric? Under what conditions could the falling sheet spring free? Do such methods of determining the profile of the spillway crest yield the maximum permissible coefficient of discharge without sacrificing either safety or structural economy? And how much leeway in design is possible without seriously changing the conditions of discharge?

Flow over a sharp-crested weir is governed by the geometrical proportions of channel and weir, and by three independent forces—gravitation, viscosity, and surface tension. If viscosity and surface tension did not

exist, geometrically similar flow conditions at different scales would also be dynamically similar; that is, the coefficient of discharge for any ratio of head to depth of approach, H/D, would have a constant value regardless of the actual magnitude of the head, and the nappe profiles would be exactly similar. Furthermore, since a frictionless fluid can exert no tangential force, the flow could not be changed by fitting the under surface of the nappe with a solid spillway section of exactly the same form. If this were done the pressure would be exactly atmospheric at all points of contact downstream from the former position of the weir crest, the same conditions of pressure and velocity would continue to exist at all points within the nappe, and the rate of discharge would remain unchanged.

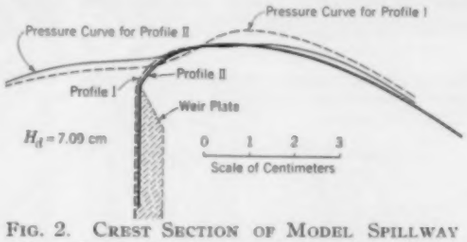

FIG. 2. CREST SECTION OF MODEL SPILLWAY WITH CURVES OF MEASURED PRESSURE DISTRIBUTION FOR PROFILES I AND II
Pressure Heads Plotted Normal to Spillway Face

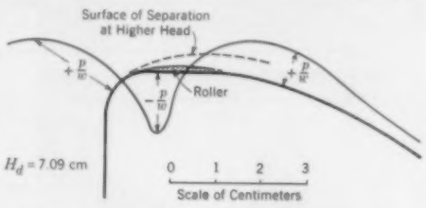

FIG. 3. MODIFIED CREST SECTION OF MODEL SPILLWAY, PROFILE III
With Pressure Distribution at Designed Head and Surface of Separation at Higher Head

Although gravity is the primary force that acts in the flow of water over a weir, viscosity and surface tension play significant rôles in altering the magnitude of the discharge coefficient. The extent to which viscous forces affect the discharge is not as yet well known; however, it has been definitely established that the effect of surface tension varies approximately with the reciprocal of the head, thus being greatest for low discharges. Hence accurate results cannot be expected if the nappe profiles of small weirs are used to prophesy conditions for large spillways.

It is apparent that studies of small-scale models in the hydraulic laboratory cannot alone be depended upon to give accurate quantitative values for determining the behavior of much larger prototypes. Only a series of studies of the same structure at various scales will give the essential key to the interrelation of the three basic physical forces as the scale ratio changes. On this phase of the subject, the late Fr. Eisner's work, "Ueberfallversuche inverschiedener Modellgrösse," *Mitteilungen der Preussischen Versuchsanstalt für Wasserbau und Schiffbau* (Berlin, 1933), is of interest; also that of M. L. Escande, "Étude théorique et expérimentale sur la similitude des fluides incompressibles pesants," a thesis for the doctorate at the University of Toulouse (France, 1929). However, studies of small-scale models can provide very significant qualitative information. Furthermore, if a model spillway crest patterned after flow over a weir of the same dimensions behaves as expected, it is only logical to conclude that a large spillway will follow just as surely the nappe of a correspondingly large weir. Determination of the profile of very large nappes is not possible in the usual hydraulic laboratory. Therefore this would be a most desirable project to be undertaken by such an institution as the National Hydraulic Laboratory at Washington and would supply greatly needed data.

A hydrodynamical approach to the problem of curving flow, such as that over weir crests, shows that conditions at any point in the flow are dependent upon those directly upstream. Thus it has been demonstrated by Bazin and other investigators that any change in the crest of a weir will result in a change in the nappe profile. Logical as this reasoning may seem, designers are prone to determine carefully the downstream curve of the spillway face, and then proceed to round off, bevel, or prolong the short upstream curve to suit their fancy—despite the fact that the downstream curve most emphatically depends on this curve which they modify.

In order to study a spillway properly designed according to the profile of the nappe over a sharp-crested weir of the same proportions, and to illustrate the effect of a change in curvature in the immediate vicinity of the crest, experiments were made to determine the flow profile of discharge over a weir 40 cm (about 1.3 ft) in height under a head of 8 cm, and to investigate the pressure and velocity distribution throughout the flow. The spillway model is shown schematically in Fig. 1. Based on the measured curve of the lower surface of the nappe, a spillway section was accurately modeled in concrete and provided with 11 piezometer inlets at intervals over the vertical and curved surfaces in the region of the crest. In this way it was possible to measure discharge, profile, and pressure distribution during flow over this spillway under the same head, and compare these values directly with the previous results. Moreover, the crest of the spillway could be varied either by cutting away or by building up with plasticine to any desired form.

In the case of the weir, surface tension causes the nappe to spring loose a short distance below the crest rather than at the sharp upstream edge, due principally to the small width of the crest, which is never made absolutely sharp. However, the relative capillary effect diminishes as the head increases. Hence, some change was to be expected in the case of the spillway model, since the inserted body completely prevented the action of surface tension. Not only was the discharge over the spillway model actually lower than that over the weir by about 3 per cent, but the piezometers indicated a positive pressure at the top of the spillway curve, as shown in Profile I, Fig. 2. This influence was removed by rubbing down the vertical face of the model by an amount equal to the width of the weir crest, that is, 0.5 mm. While the differences in curvature were slight, the pressure variations were considerable. In this form, Profile II, the spillway gave a discharge only 0.7 per cent lower than that of the weir, and the pressure along the curves surface in the crest region did not vary from the atmospheric by more than a negligible fraction of the head. No further efforts were made to reduce these slight discrepancies.

In addition to this ideal form of crest, two other common designs were tested, one with a short horizontal section at the top (Profile III in Fig. 3), such as is frequently encountered in practice, preceded by a short curve of constant radius; and the other (Profile IV in Fig. 5) with a lip projecting upstream. Both profiles followed the ideal curve except as noted. Each of these crests resulted in a pressure distribution different from that for which the downstream curve was designed. As may be seen from Fig. 3, the departure of the first of these two from the ideal curve is by far the more marked, since the change in form lies more nearly in the region

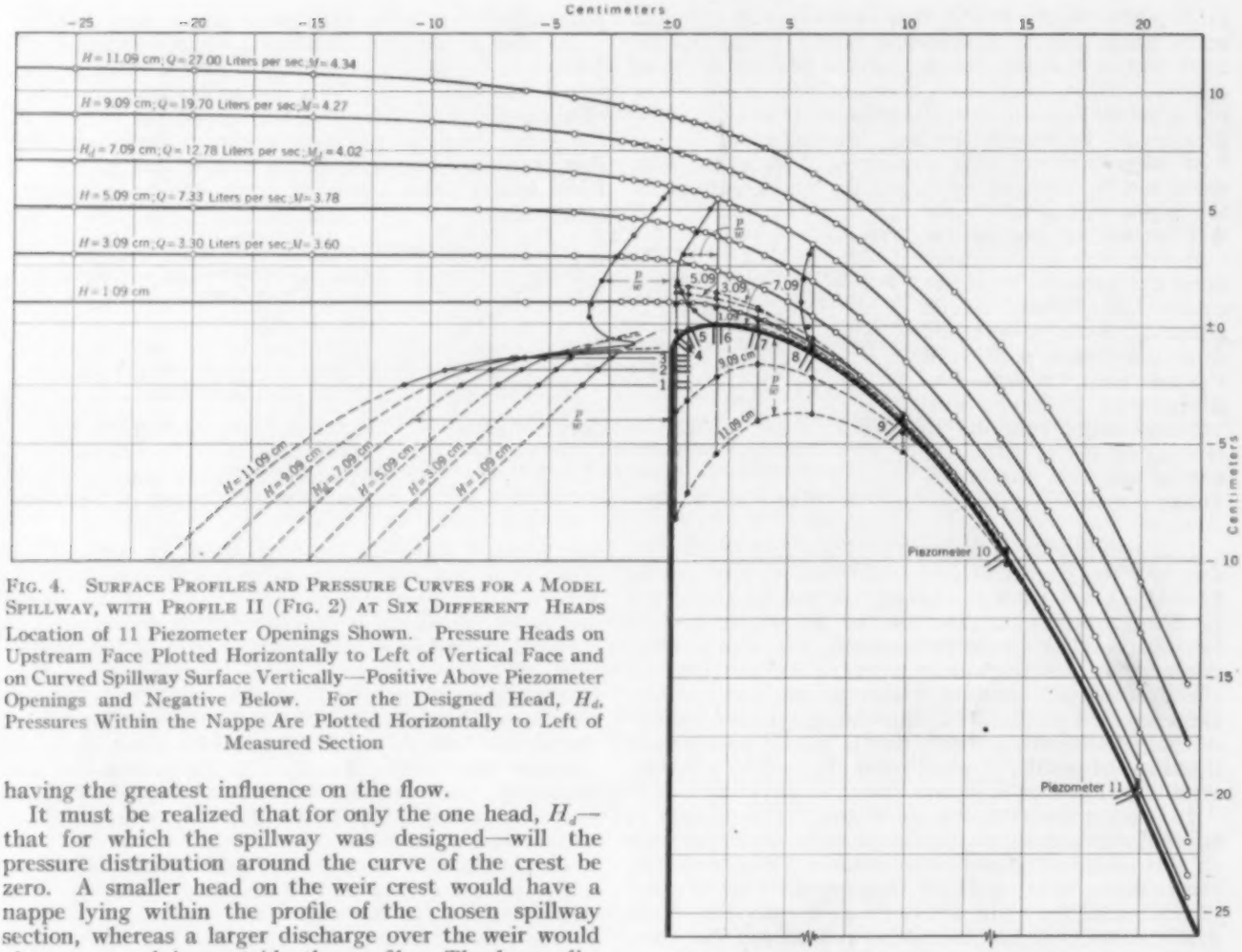
Centimeters
H = 11.09 cm; Q = 27.00 Liters per sec; M = 4.34
H = 9.09 cm; Q = 19.70 Liters per sec; M = 4.27
H = 7.09 cm; Q = 12.78 Liters per sec; M = 4.02
H = 5.09 cm; Q = 7.33 Liters per sec; M = 3.78
H = 3.09 cm; Q = 3.30 Liters per sec; M = 3.60
H = 1.09 cm
Piezometer 10
Piezometer 11
Centimeters

FIG. 4. SURFACE PROFILES AND PRESSURE CURVES FOR A MODEL SPILLWAY, WITH PROFILE II (FIG. 2) AT SIX DIFFERENT HEADS
Location of 11 Piezometer Openings Shown. Pressure Heads on Upstream Face Plotted Horizontally to Left of Vertical Face and on Curved Spillway Surface Vertically—Positive Above Piezometer Openings and Negative Below. For the Designed Head, H_d, Pressures Within the Nappe Are Plotted Horizontally to Left of Measured Section

having the greatest influence on the flow.

It must be realized that for only the one head, H_d—that for which the spillway was designed—will the pressure distribution around the curve of the crest be zero. A smaller head on the weir crest would have a nappe lying within the profile of the chosen spillway section, whereas a larger discharge over the weir would give a curve lying outside the profile. The lower discharge, on passing over the spillway, would of necessity be forced to adapt itself to the established curve, and a certain positive pressure would exist between the sheet and the crest, forcing the nappe to follow a higher trajectory than that of free fall. Similarly, the greater discharge, the natural trajectory of which lies outside the spillway profile, would follow the established profile only through a reduction in pressure along the crest. That is to say, the sheet would be forced back against the spillway surface by the difference between the atmospheric pressure above the sheet and the less-than-atmospheric pressure beneath it. In all cases, however, the pressure would be positive a short distance past the crest.

In Fig. 4 profile and pressure curves are given for six different discharges over a crest shaped to Profile II, showing the variation in pressure conditions as the head varies from a small value to one considerably larger than H_d. A photographic record of profiles and pressure curves for the same range of H is presented in Fig. 5. The model spillway weir was set between two glass plates exactly one foot apart. All measurements were made with vernier gages reading to 0.1 mm (about 0.0003 ft). For photographic purposes the rear glass panel was covered with white tracing paper and the model illuminated from behind. Thus the water surface is visible as a black line caused by the meniscus formed along the glass wall. A few drops of potassium permanganate solution in the manometers made the water columns visible.

The pressures on the upstream face, plotted horizontally to the left in Fig. 4, deserve attention, since textbooks often refer erroneously to "impact" in this region. Hydrodynamically speaking, at the base of the upstream face—that is, at the intersection of the floor with the spillway—there is a point of stagnation, indicated in Fig. 1, where the velocity is reduced to zero because of the abrupt angle. If in this region the total head is the same as that of the average flow, this reduction in velocity head must be compensated by an equal increase in pressure head. Hence the normal static head, as given by the total depth of flow at a point where the surface of the approaching stream is still horizontal, is augmented by an amount equal to the velocity head of approach, and not by twice this velocity head as in the case of "impact." The fact that frictional losses tend to reduce the velocity along the floor only serves to reduce this stagnation pressure, as is also shown in Fig. 1. As the flow accelerates along the upstream face in the direction of the crest, the pressure drops accordingly, approaching zero as the crest is reached. The stagnation pressure becomes of appreciable magnitude with greater velocities of approach—that is, for low spillways under high heads. This was investigated over a great range of the ratio H/D.

Of primary interest to the designing engineer is the coefficient of discharge, M, in the equation $Q = MBH^{3/2}$. For a spillway this factor is generally assumed—3.8 being a common guess—and the design then proceeds by rule of thumb on the basis of this assumption. Obviously,

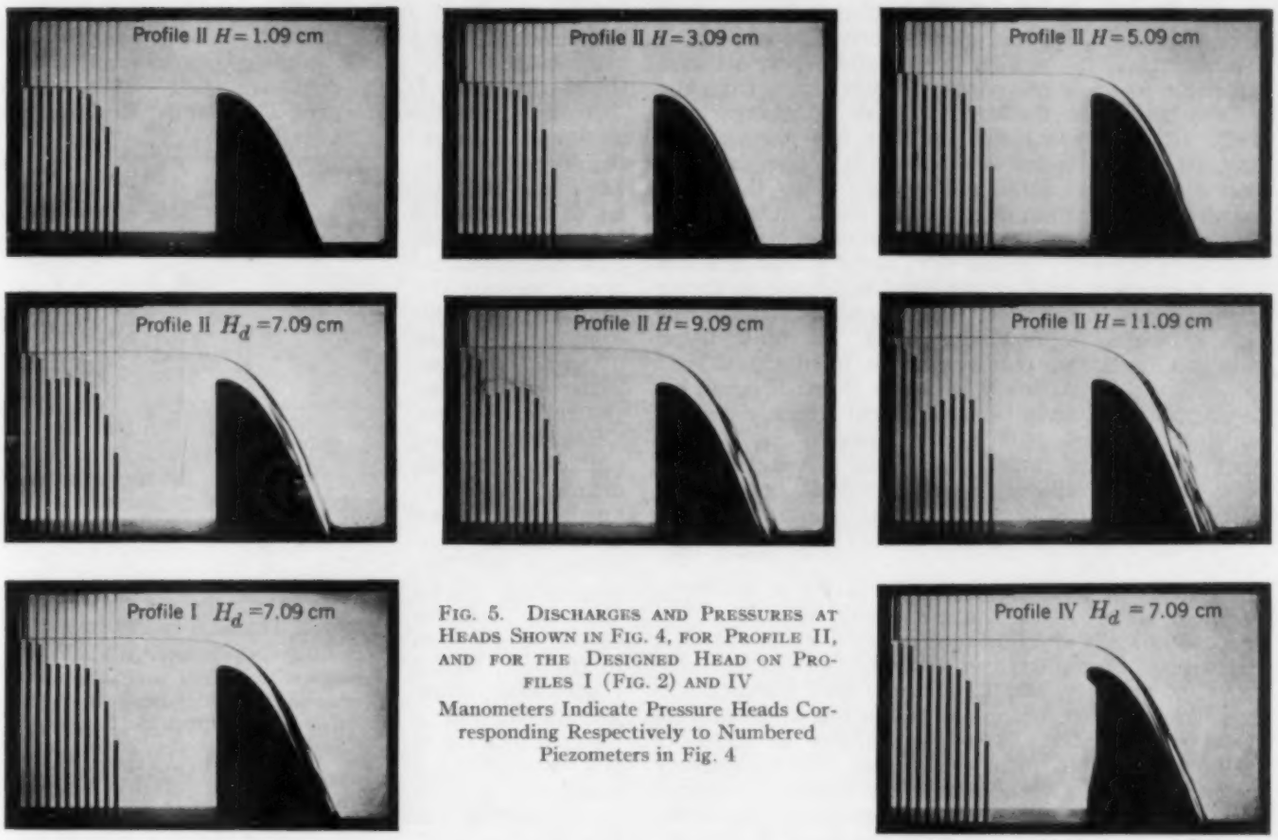
Profile II $H = 1.09$ cm
Profile II $H = 3.09$ cm
Profile II $H = 5.09$ cm
Profile II $H_d = 7.09$ cm
Profile II $H = 9.09$ cm
Profile II $H = 11.09$ cm
Profile I $H_d = 7.09$ cm
Profile IV $H_d = 7.09$ cm

FIG. 5. DISCHARGES AND PRESSURES AT HEADS SHOWN IN FIG. 4, FOR PROFILE II, AND FOR THE DESIGNED HEAD ON PROFILES I (FIG. 2) AND IV

Manometers Indicate Pressure Heads Corresponding Respectively to Numbered Piezometers in Fig. 4

definite knowledge of the magnitude of this factor is far preferable to guesswork. As a matter of fact, if the profile of the corresponding weir nappe is followed exactly in designing the crest, not only can the discharge under the designed head be foretold with negligible error, but the complete rating curve for all heads is definitely established.

Measurements on the weir nappe for an 8-cm head gave a value of 3.39, in English units, for the coefficient M_w and the maximum elevation of the lower surface above the crest amounted to 0.91 cm. It will be noted that this is somewhat lower than Bazin's average value of 0.13 H, because of the increased capillary effect at low heads. Using the crest elevation as the zero level of the spillway itself, the head on the spillway would then be 7.09 cm, which gives the spillway coefficient, M_d, the value of 4.05. That the actual measurement of discharge over this spillway (Profile II) under the 7.09-cm head resulted in a value of 4.02 for M_d is ample proof of the accuracy which may be obtained by careful design. The measured coefficients for Profiles I, II, and IV are, respectively, 3.93, 3.89, and 3.97. A lip in the upstream side does not appreciably influence the discharge, since the effect of the slight reversal of flow is offset by the increased curvature of the filaments.

In general it may be said that negative pressure in the region of the crest is accompanied by an increase in the discharge coefficient, whereas a positive pressure signifies that the coefficient is reduced. This generalization holds not only for changes in profile under the given head, but for a variation in head as well. The plot of the discharge coefficient against the head for Profile II, given in Fig. 6, shows this relationship clearly. Of great importance is the fact that as the head increases beyond its design value, the rate of increase of the coefficient approaches a minimum. Further increase in the head will continue to reduce the pressure on the crest surface, because of the relatively greater curvature of the stream filaments; yet the resulting increase in velocity is compensated by a gradual reduction in the rate at which the depth at the crest increases, since the sheet is deflected from its natural course with increasing abruptness.

The curve of H against M, as plotted in Fig. 6, applies only to the given value of H/D. This ratio will vary from nearly zero for very high spillways to unity for the free overfall; it will be found that the coefficient M for any designed head will increase with H/D, approaching its maximum value of $\sqrt{g}$, or 5.67, for extremely low spillways under great head. In this higher range, the coefficient will approach this constant value for all heads, since the discharge over the free overfall is at the critical point and is independent of the crest form.

From this discussion it would appear that the most economical head under which to operate a spillway would not be the designed head H_d, but somewhat higher on the curve, where M has attained a greater value. Yet designing engineers have not taken advantage of this fact through fear that the nappe would separate from the spillway face the moment a negative pressure occurred at any point. The curve of the discharge coefficient M, taken from Creager, becomes constant at 3.94 and ends abruptly when H becomes H_d (Fig. 6). Many texts advocate extending the downstream part of the spillway some distance into the normal profile of the free sheet as a sort of safety factor—but at the same time they unwittingly modify the upstream part of the curve in such a way that the pressure at the crest will often be less than atmospheric. It should be repeated, therefore, that it is not the downstream face but the entire upper region of the crest which influences the

pressure distribution; and this region influences just as certainly the dangerous phenomenon of separation.

With each of the profiles investigated, every attempt was made to cause the nappe to spring loose from the spillway under the maximum available discharge head of 1.6 H_d. Air was blown into the flow through the piezometer tubes; piers were built in at both ends of the crest to allow free passage of the air along the sides; and the sheet was even disrupted by hand. Only in the case of Profile III was it possible to cause a surface of separation to form. In this case, under a head of about 9 cm, separation could be produced with ease, as shown in Fig. 3, the entire sheet then remaining free of the spillway face for an indefinite period. It will be noted from this illustration that even under the designed head the stream had left the face over a short distance, beginning with the abrupt change in curvature, the space below being filled with a small roller. The obvious conclusion is that sudden changes in curvature are to be avoided, for although a roller may at first fill the region of separation, negative pressure at this point will facilitate the entrance of air at either end of the crest to replace the roller.

As a further example of the formation of rollers at points of abrupt change in curvature, the case of the Puechabon spillway in France is cited, since this is a design often encountered in Europe. Results of measurements made by M. L. Escande at Toulouse, previously referred to, are reproduced in Fig. 7, taken from model studies of the 13-meter spillway at scales of 1:19.5 and 1:100. The illustration shows definitely the two surfaces of separation at the points of too-rapid change in the profile curve. The pressure curve is worthy of careful study in the light of the foregoing discussion.

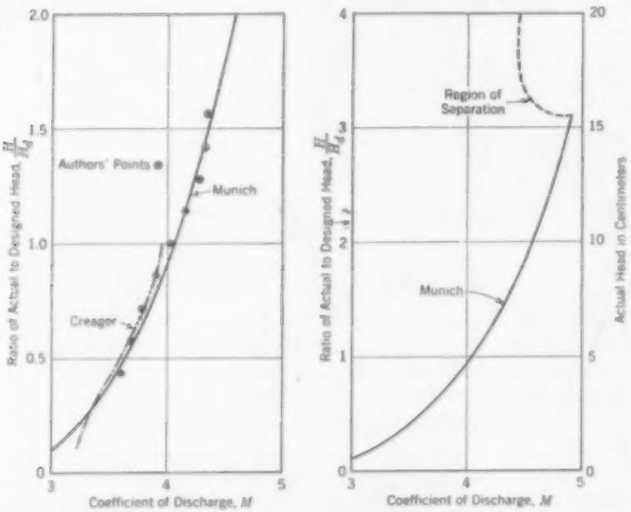

FIG. 6. VARIATION OF SPILLWAY DISCHARGE COEFFICIENT WITH RATIO OF ACTUAL TO DESIGNED HEAD FOR PROFILE II

Also Curves from Creager's "Masonry Dams" and Dillman's "Untersuchungen an Ueberfällen" (Munich). At the Right the Munich Curve Is Extended to and Beyond the Head at Which the Sheet of Water Separates from the Spillway Surface

At no point along the continuous curve of Profile II is it possible for such a roller to exist. For the same reason, if air is introduced at any point, it will immediately be carried downstream, because the steady change in curvature is sufficient to ensure against separation even under relatively high heads. Obviously, however, even for the ideal crest there is a limiting head under which the curvature becomes excessive, and for which a clinging sheet is impossible. Unfortunately, laboratory facilities did not permit increasing the head on the model spillway to such an extreme magnitude, which would probably be several times the normal head, H_d.

Recently the laboratory of Dr. Thoma in Munich undertook an extensive investigation somewhat similar to the studies here described, determining the variation of pressure and discharge coefficient for spillways of various scales patterned after the general weir nappe. This work is reported by O. Dillmann in "Untersuchungen an Ueberfällen," Mitteilungen des Hydraulischen Instituts der Technischen Hochschule zu München, Heft 7 (Oldenbourg, Munich, 1933), and is referred to in Fig. 6. His crest section was made of hardwood, and the curve was approximated by a combination of ellipse and parabola which did not exactly correspond to the measured curve of the weir nappe.

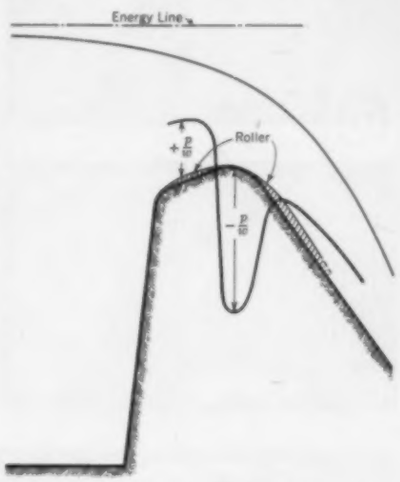

FIG. 7. PROFILE OF PUECHABON SPILLWAY, FRANCE

Pressure Distribution and Regions of Separation Under Normal Discharge, as Determined by Escande from Model Experiments at the University of Toulouse

He found that the head could be increased on his model spillway from the designed head of 5 cm to a magnitude of 15.5 cm without separation of the sheet at any point. As was to be expected, the curve of the coefficient M varied smoothly to this maximum value, as shown in Fig. 6. With a head of 16 cm, however, the entire discharge profile had changed, the sheet separating from the crest near the beginning of its curvature and the space underneath being filled by a roller of the type already discussed. The formation of this roller was accompanied by an increase in the radius of curvature of the nappe and hence by a decrease in pressure along the spillway face and a corresponding rise in the surface level. It will be seen that the coefficient of discharge drops abruptly at this point and then rises only slightly with increasing head.

Although such experiments on small models as are here discussed cannot be expected to give accurate quantitative results for the operation of large-scale spillways, qualitatively their indications are of direct importance in actual design. On none of these model tests was separation encountered with a head less than about three times that for which the crest was designed. Although such negative pressure may be possible in models, in the enlargement to full size for the case of a large spillway it may approach the vapor pressure of water—nearly absolute zero—under which conditions cavitation will result. In the Munich tests approximately 13 times the designed head, or over 4 times the maximum head, was discharged over the spillway without separation. While the resulting negative pressures can by no means be neglected, it is evident that the existing fear of separation on correctly designed spillways, even under an appreciable overload, is greatly exaggerated.

Precautions in Building Design

Pitfalls Avoided by Experienced Designers and Constructors

By Elwyn E. Seelye

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PERSONAL experience is the best teacher; probably next in order is the experience of others. The young engineer ought to be able to derive valuable information from a description of faults in structures. Here the author draws on his own knowledge and experience to point out a series of mistakes commonly made in the design of buildings, which too often are reproduced in construction to the consternation of the designer and the chagrin of the inspector. It is Mr. Seelye's hope that a study of the examples given in this article may shorten the time required by the novice to gain personal experience and hasten his acquisition of a professional status. The material in this article was presented by Mr. Seelye before the Ithaca Section of the Society at a meeting held on January 22, 1934, on the campus of Cornell University.

SANITARY, hydraulic, and industrial engineers, as well as structural and bridge engineers, are constantly designing structures that are expected to render a certain service, but which quite often develop the most embarrassing defects. So basic is the structural problem to engineers and architects, that it may be said to bear the same fundamental relation to practical construction that mechanics bears to engineering theory.

A knowledge of mechanics, plus a knowledge of materials accurately applied, should enable a designer to plan any kind of structure so that it will serve its purpose, and not develop defects. As a matter of fact, this often is not the case. Another invaluable factor in the situation is experience, which tends to eliminate the mistakes that creep into designs because of oversight or faulty reasoning on the part of the engineer or failure to provide for the obscure actions of nature.

A craftsman should not be required to do something in a different way, or to attain a greater degree of skill than he ordinarily has. If the success of a design is predicated on the assumption that he can exceed his customary ability, a failure is likely to result. An example of a difficulty arising from an obscure action of nature would be that of insufficient provision for temperature stresses.

The more experience the designer has, the more humble he should become, as he sees the thousand and one possibilities for error and, perhaps, catches serious mistakes at the last moment. No engineer can design and build perfectly without the aid of experience, and the road to experience is a long, weary, and sometimes costly one. However, a study of errors made by others may serve as a concentrated dose of experience and tend to shorten and ease the process of obtaining this asset. This is particularly true because a great many of the errors that will be explained here are similar in nature, although different in form.

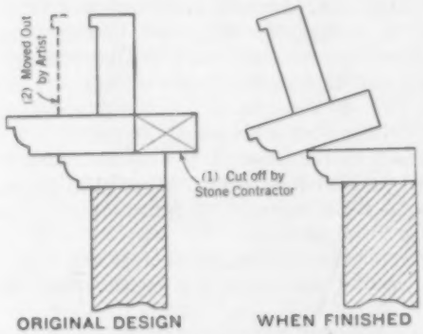

Fig. 1. Changes in Design Produce an Unstable Cornice

It will be noted that the errors of incorrect application of mechanics are not emphasized in this article, except where they relate to a shortcoming in the human factor in the designer, the inspector, or the constructor. The reason for emphasizing errors of this type is that they are much more difficult to eliminate than are errors of incorrect theoretical engineering.

In Fig. 1 is shown a mistake that occurred in the office of a prominent architect, whose sense of humor was such that he told about the error as though it were a good story. On a certain public building the cornice was originally designed with stable proportions. As the cost of the stone was figured on a cubic-foot basis, the contractor suggested that the rear of the main cornice stone might be omitted in order to save the owner money. This suggestion was adopted by the architect's office. The parapet above the cornice was next moved outward at the suggestion of an architectural draftsman of artistic inclination. The resulting structure was unstable. This error was due to faulty administration, that is, to a failure on the part of the architect's organization to keep in touch with the structural engineer when making seemingly unimportant structural changes. The moral of it is that the artist should not allow himself to become separated from his pilot, the engineer.

A common problem arises during the removal of the first-story fronts of buildings in order to place show windows. Generally the plans call for adequate steel to carry the original wall above the windows

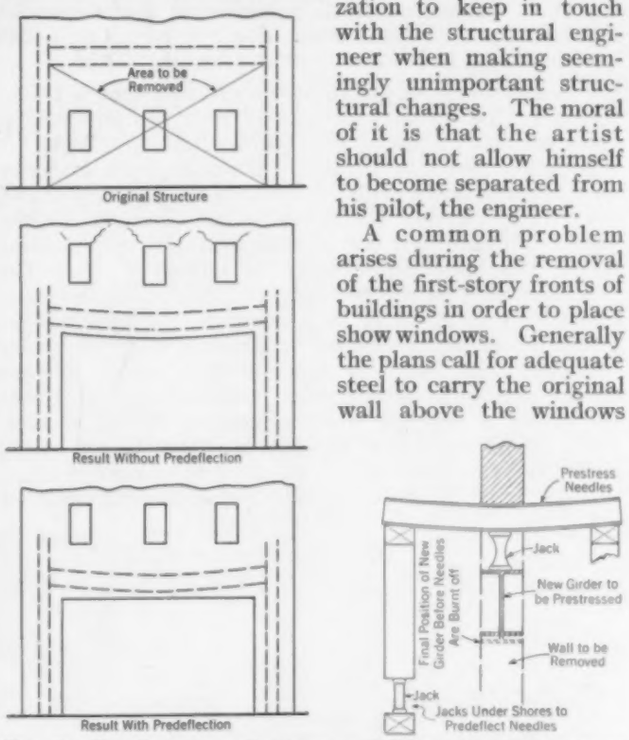

Fig. 2. Pre-Stressing Structural Members in Remodeling Operations

Masonry Cracks Prevented by Proper Construction Procedure

after the operation is completed, but the operation itself is fraught with danger and requires considerable care. Often the architect disclaims all responsibility for the field work and leaves the execution of the work entirely to the contractor. The result of this often is that the constructor, if he is without engineering training, allows the front wall of the building to sag from, say, $\frac{1}{2}$ to 1 in., with the result shown in Fig. 2.

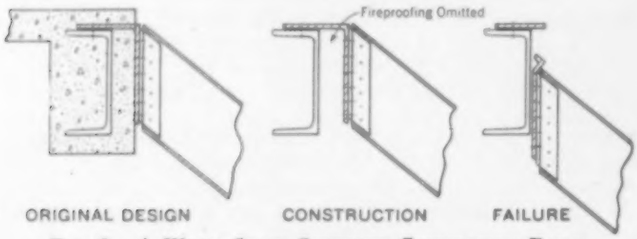

FIG. 3. A WEAK STAIR STRINGER CONNECTION FAILS

In general this is due to the failure to pre-stress and pre-deflect the steel girder before the wall load is transferred to the girder. Of course, it is obvious that if the load is transferred to a girder that is straight, it will deflect and take a curve. Ultimately the masonry would move down with it, forming an ugly soffit and very likely causing the development of cracks in the ashlar. In addition the needles should be pre-stressed before the wall below them is removed. How the members may be pre-stressed, as required, is also indicated in Fig. 2. The jack transfers the load to the girder before the needles are removed, forcing the girder to deflect. At the same time the jack presses upward on the needles until deflection computations show that the girder is carrying the load instead of the needles. Then the masonry can be placed between the top of the girder and the wall, and the needles can be burned off.

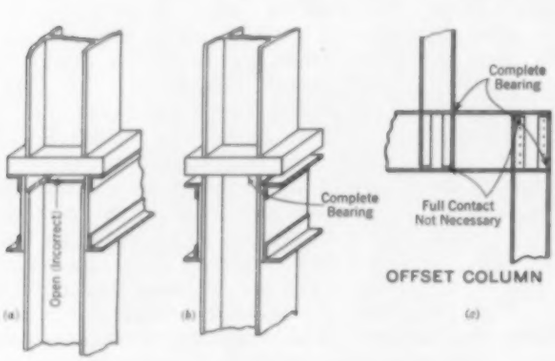

FIG. 4. SHOWING IMPORTANCE OF PLACING CERTAIN SURFACES IN CONTACT

This type of error—namely, the development of cracks in a building during the operation of replacing bearing walls with steel supports—is due to two causes. Either the planner overlooked the effect of the natural elasticity of the beams, or it was again a matter of poor administration. The engineer who planned the design should have followed the work through in the field.

Recently one of the main stair stringers in an important structure broke loose from the supporting channel, as shown in Fig. 3, and dropped down. Fortunately ladder action kept it from dropping to the floor. The design showed that this stringer was supported only by a hook formed from the outstanding leg of what would usually be a connecting angle. The hook connection has practical merit, because it eliminates field drilling of the supporting channel for connection bolts. It is a device that originated with the stair builder. However, the concrete fireproofing called for was omitted from the floor channel, so that the stringer was actually supported on the tip of the hook, as shown.

Although the obvious weakness of the design was aggravated by the omission of the fireproofing from the channel, the fundamental cause of the failure was the elimination of the engineer due to the somewhat common practice of trusting the ornamental iron contractor to design his own structures without technical supervision. Also, the field superintendent failed to exercise proper vigilance when he permitted the fireproofing to be omitted. This again is an example of faulty administration.

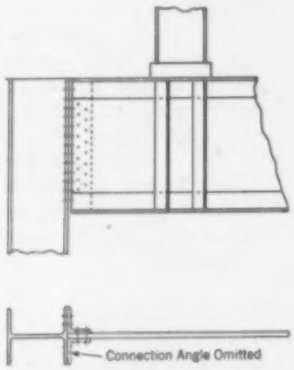

FIG. 5. IMPORTANT CONNECTING ANGLE OMITTED BOTH BY SHOP AND ERECTION INSPECTOR

In Fig. 4(*a*) the sketch shows an upper column bearing on the twin floor girders rather than directly on the lower column. The correct design is shown in Fig. 4(*b*). Simple as this error is, it represents an important class of similar errors relating to the vital importance of having certain surfaces in contact in steel assemblages. It points out an important lesson, not only to the designer but to the shop and field inspector.

The checker of the shop drawings may have been at fault. If the drawings were correct, the shop and field inspector should have caught the incorrect fabrication. They should be "stress conscious," that is, they should realize how stresses are transmitted and should check up on the vital links in the chain. For instance, a perfect bearing of some girder stiffeners is required only on one end, as shown in the case of the offset column shown in Fig. 4(*c*), and as it is often difficult to get a good bracing at both ends, stress consciousness on the part of the inspector is important.

Another example of the importance of stress consciousness on the part of the inspector is indicated in

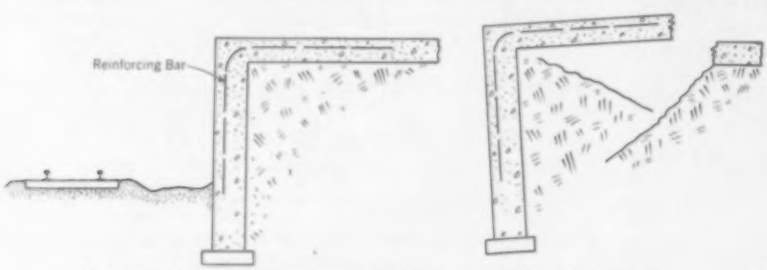

FIG. 6. INSUFFICIENT ANCHORAGE IN A MILK PLATFORM

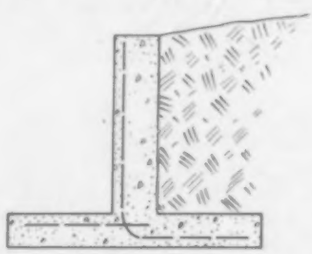

FIG. 7. RETAINING WALL IMPROPERLY REINFORCED

Fig. 5, which shows a girder carrying an offset column. Surely no inspector need be told of the importance of connecting the girder to the lower columns. However, one connection was omitted in shipment, and the inspector passed the connection with but one angle in spite of the open holes remaining in the lower column. The designing engineer, who was of course stress conscious, discovered the omission just before the fireproofing was placed. The lesson to be learned from this is that delegating the checking of shop drawings and shop and field inspection to men who are not stress conscious is dangerous and should be supplemented by the supervision of the designing engineer. These are examples of faulty reasoning and oversight.

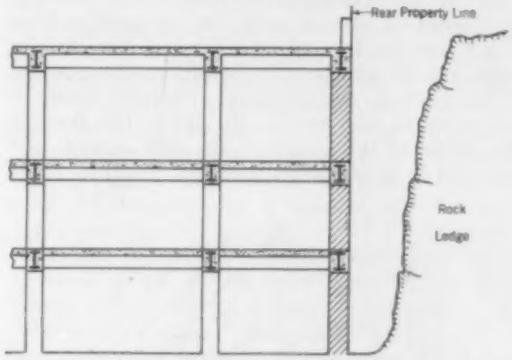

FIG. 8. STEEL SKELETON OF BUILDING FAILED WHEN OWNER OF REAR PROPERTY BACKFILLED

Some examples of weaknesses in retaining walls, which are not due to the ordinary causes, are shown in Figs. 6, 7, 8, and 9. In Fig. 6 is shown a milk-platform wall in which an attempt was made to provide the necessary stability against overturning by tying the top of the wall back into the floor slab by means of reinforcing bars. These bars were not carried back far enough beyond the line of slip; therefore the wall failed. In this case the designer recognized the necessity of taking care of overturning but failed to carry through. It is an error of confused mechanics.

In Fig. 7 there is an illustration of what might be called an error in interpretation. An architectural draftsman, who was not at all stress conscious, was furnished with the necessary proportions and reinforcement for a cantilever concrete wall. However, he placed the steel on the wrong side of the wall, and it fell down. This is an administrative error, because the engineer who furnished the data should have approved the final drawing.

A vertical section through the rear of a bank structure is shown in Fig. 8. As soon as the walls and steel skeleton of this building were erected and before the concrete flooring, which would have had a stabilizing effect, had been placed, the owner of the property in the rear filled up the crevice that was left between the property line and the rock ledge. This resulted in the collapse of the steel skeleton frame. This particular failure was due to lack of imagination on the part of both the architect and his engineer, but as in many such errors it seems as if fate were lying in wait for the designer with all sorts of traps.

A case of failure to provide for the action of an obscure natural force and a case of "bootstrap" support are shown in Fig. 9. This drawing represents two walls in an existing building, one of which is to receive new underpinning and permit adjacent excavation to a lower level, thus producing a temporarily unbalanced retaining wall action against the wall that is being underpinned. The necessity of reducing the action of this retaining wall resulted in placing a tie-rod between the two walls, so that the second wall would be capable of supplying resistance. As a matter of fact, this second wall was located well beyond the natural angle of slip, but the horizontal thrust induced in this wall by the tie-rod pull actually so flattened the angle of slip that the resulting construction was in a dangerous condition. Of course, the obvious way to provide against such an error would have been to place a line of spur shores, as shown in the dotted part of Fig. 9, until the supporting thrust of the floor beams of the new building became effective. This error is again one of confused mechanics, or faulty reasoning.

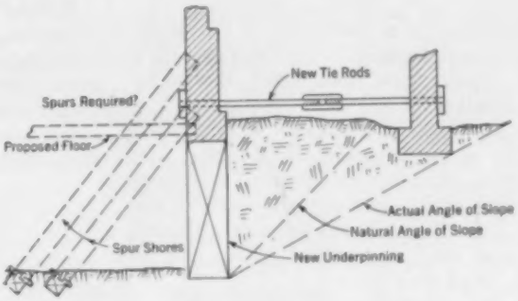

FIG. 9. TIE ROD CHANGES ANGLE OF REPOSE
Temporary Spur Shores Would Have Provided Required Support

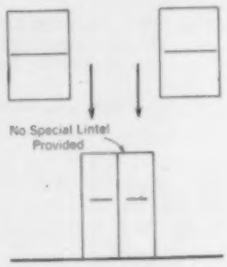

FIG. 10. FAILURE TO PROVIDE PROPER LINTEL OVER OPENING IN AN INTERIOR BEARING WALL

It is the general practice in building construction to draw plans of exterior elevations, but the interior bearing walls of a structure are not generally shown on elevations. This may result in overlooking weaknesses in the interior bearing walls, as illustrated in Fig. 10.

It is excellent practice for the engineer to draw up all of his interior bearing walls, so that he may visualize the action of the stresses as they are carried down. An error of the type shown in Fig. 10 is due primarily to obscure plans, where an engineer is working with architectural plans that do not show up conditions completely. This is apt to be particularly true in the case of foundations. The engineer should supplement such incomplete drawings in order to be on the safe side.

Foundations for such structures as walls and columns that place great pressure on the earth underneath them should be lowered in accordance with the elevations of the bottoms of adjacent footings, Fig. 11. A favorite rule of thumb is to make the slope line between the bottoms of the adjoining footings not steeper than one vertical to two horizontal. In the same way, where the wall footing is raised, the change should be made gradually by steps rather than by an abrupt lift.

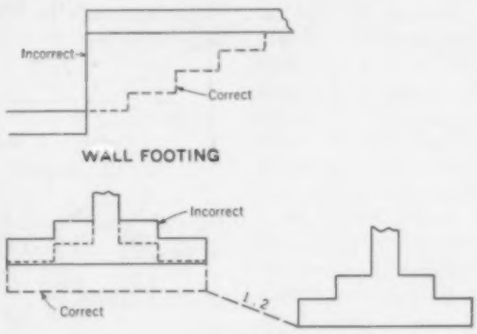

FIG. 11. STEPPING DOWN FOOTINGS TO MAINTAIN STABILITY OF FOUNDATION MATERIAL

Inadequate exploration of the material under footings is often a

source of trouble. In one case, the footings were designed for hard rock and one footing was built over a pocket of soft rock, resulting in a very serious settlement in that spot. In another case a bad accident was averted

FIG. 12. INADEQUATE PROVISION FOR AN INTERMEDIATE LOAD IN A HOSPITAL BUILDING

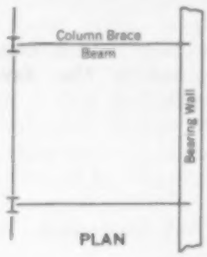

FIG. 13. COLUMNS INSECURELY BRACED

by the accidental discovery of a cavity in a limestone formation under a proposed footing. In the case of a limestone formation, exploratory drill holes should be made under each foundation.

In Fig. 12 there is represented a slightly exaggerated condition existing in a semi-public building. The architect relied on a subcontractor to furnish the design of a structural alternate, which was not checked by the architect's engineer. The alternate was not strengthened for serious superimposed loads in certain places due to heavy partition work, with the result that the stress in the concrete and steel ran up dangerously high. One may picture the architect fighting a moral battle with himself as to whether he will confess his error or continue to assume the risk. Adequate reconstruction would run into many thousands of dollars. The lesson to be learned from this mistake is that free information is worth about what you pay for it.

No discussion of accidents would be complete without bringing up the question of inadequate bracing. Take, for instance, the case illustrated in Fig. 13. Let us suppose that the columns are spliced at the floor. The only brace that these columns receive at this splice would be the beam running into a bearing wall. In many cases this would be totally inadequate, because if the stresses in the column were large the horizontal stability of the bearing wall would not be sufficient to support the column laterally.

In Fig. 14(*a*) are shown two roof truss designs. In general, these trusses tend to collapse if they do not have adequate support, such as a line of vertical bracing, as shown in Fig. 14(*a*) or a line of top-chord bracing with a vertical component, as shown in Fig. 14(*b*). Bracing is an obscure natural phenomena because, except in the case of wind, it is difficult for an engineer to evaluate the required strength. In my practice I use a rule that calls for 2 per cent of the direct stress as the amount required to completely brace a column at a certain level. This is arrived at by imagining a column erected sufficiently out of plumb to produce a horizontal thrust of 2 per cent. For instance, for a column 12 ft high and 2.8 in. out of plumb the horizontal result would be 2 per cent of the axial load. Of course, this may seem extreme, but when the effects of inadequate squaring of the base are considered, there are plenty of columns that are in effect 2 in. out of plumb.

An expansion failure is shown in Fig. 15. This building, which was some 700 ft long, was anchored at the shore end, because of the greater resistance of the shorter columns to bending. At one point, an old sea wall restrained one of the outshore columns, with the result that it completely sheared off. This, of course, is illustrative of the action of one of the more obscure forces of nature and is probably the reason for a great many partial failures of structures.

There is no subject more difficult to treat satisfactorily than expansion, because it is always present. Furthermore, a large amount of it is taken up by the elasticity of the structure, so that the engineer faced with the complication of expansion joints must ask himself, how much expansion will be taken up by the elasticity of materials and where he must begin to use expansion joints in order to prevent unsightly or dangerous cracking.

Some safe rules of design may be summarized as follows: (1) Keep the human equations of the builder and the inspector in mind. (2) Reinforce the routine inspection by having the designer oversee vital or complicated parts of the work. (3) Keep the designs down to the plane of the builders, the fabricators, and the erectors. This is sometimes called "foolproof designing." (4) Do not forget the law that action and reaction are equal and opposite: many designs take care of the action without properly considering the reaction. (5) Remember that a weakness in a structure may not be obvious and that the responsible engineer must be constantly on the alert. (6) Be sure to visualize the structure completely. It may be necessary to draw up additional sections or elevations so that the problem can be seen in its entirety.

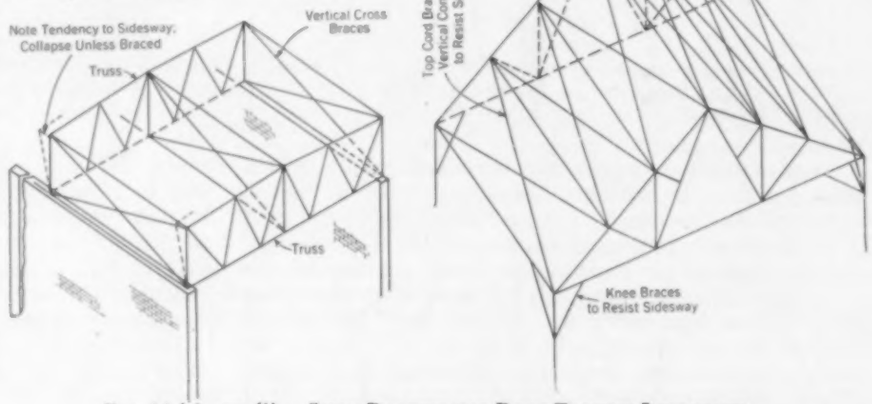
Note Tendency to Sidesway; Collapse Unless Braced
Truss
Vertical Cross Braces
Truss
Top Cord Bracing Has Vertical Component to Resist Sidesway
Knee Braces to Resist Sidesway

FIG. 14 (*a*) AND (*b*). SWAY BRACING FOR ROOF TRUSSES IMPORTANT

The foregoing examples have been given as a sort of compendium of experience. It is hoped that they may lead engineers to form the habit of treating a problem in perspective as well as in detail.

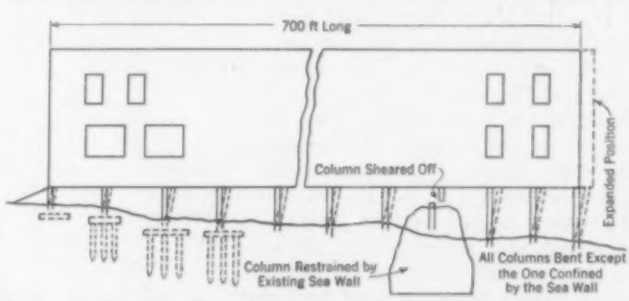
700 ft Long
Column Sheared Off
Expanded Position
Column Restrained by Existing Sea Wall
All Columns Bent Except the One Confined by the Sea Wall

FIG. 15. EXPANSION IN A LONG STRUCTURE SHEARS OFF A COLUMN

Design of Steel Sheet-Piling Cofferdams

Considerations Governing Selection of Piles and Design of Wales and Bracing

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THERE is economy in building substantial cofferdams, for when well designed and constructed they will save pumping costs, eliminate anxiety regarding stability, and prevent costly accidents. Any savings effected by doubtful construction fade into insignificance when compared with the risks taken. Each detail must be investigated: the spacing and size of the wales, the selection of the proper section of steel sheet piling, the design of the internal bracing, the driving of the sheeting, its penetration, its unwatering, and excavation within it. The two authors of this article have here translated their study and experience into helpful data for ready reference by those confronted with the problem of designing cofferdams of sheet piling.

THE single-wall cofferdam is an enclosure of steel sheet piling driven into soil or to rock. The inside of the enclosure is unwatered and excavated for the purpose of building a structure there. In order that the cofferdam may resist collapse from the external pressure of water and soil, it must be braced internally by a system of wales and struts.

Design procedure divides itself into two steps: a study of the sheet piling, and a study of the bracing. The sheet piling must have sufficient beam strength between the lines of wales to resist the external loads, and sufficient penetration into soil to prevent excessive leakage underneath the piles and to keep the bottom of the cofferdam from "blowing up." The penetration must also be deep enough to develop in the soil sufficient passive resistance to support the bottom of the sheeting.

Wales and struts must be of a size sufficient to support all construction loads in addition to the loads delivered by the sheeting, and they must be so spaced that the beam strength of the sheeting is not exceeded. The cofferdam should also be properly framed and braced against lateral movement by means of tie rods, posts, and diagonal members.

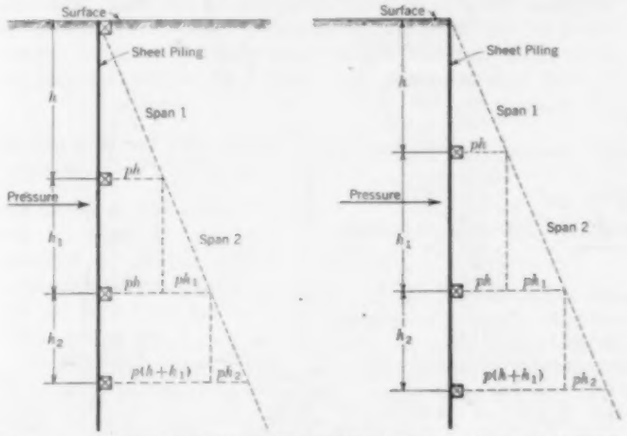


FIG. 1. DETERMINATION OF WALE SPACING FOR EQUAL BENDING MOMENT IN EACH SPAN
(*a*) Wale at Top of Cofferdam (*b*) Cantilever Top Section

All external pressures are assumed to be liquid, that is, directly proportional to the depth. The weight of soil is expressed as an equivalent horizontal liquid pressure by means of the Coulomb formula. If the soil is submerged, the increment of pressure will be the weight of water per cubic foot plus the weight of the submerged soil resolved into a horizontal pressure through its angle of repose—or angle of internal friction, if that can be determined—by this formula.

Almost invariably, the first step is to find the lowest position in which the top wale can be placed in order to develop the full beam strength of the sheet piling in the top span under the external pressure. The problem is illustrated in Fig. 1. There are two usual conditions for this top span: first, a wale at the top of the cofferdam; and second, a cantilever top section. When the wale is at the top, the bending moment in the sheet piling is that of a simply supported beam supporting a uniformly increasing load. Thus the section modulus, S, required in the sheet piling is:

$$S = \frac{ph^3 \times 12}{9\sqrt{3f}} = \frac{ph^3}{1.30f} \quad \ldots\ldots\ldots [1]$$

In a cantilever top section,

$$S = \frac{\frac{ph^2}{2} \times h \times 12}{3f} = \frac{2\,ph^3}{f} \quad \ldots\ldots\ldots [2]$$

Practically, the problem is the determination of what top span, h, is possible for a section of sheet pile having a given section modulus. This can be readily calculated by reversing Equations 1 and 2. When there is a wale at the top, this maximum span is:

$$h = \sqrt[3]{\frac{1.30\,f\,S}{p}} \quad \ldots\ldots\ldots\ldots [3]$$

For a cantilever top section:

$$h = \sqrt[3]{\frac{f\,S}{2\,p}} \quad \ldots\ldots\ldots\ldots [4]$$

A safe working stress in the steel, f, is selected according to the judgment of the designer. For water pressure only, the load on the sheet piling is known exactly, so that the safe working stress can be very much closer to the elastic limit of the steel than would be possible for earth pressures, which cannot be theoretically predicted with accuracy. A lower working stress for the latter case is an added factor of safety.

For all spans except the top one, the bending moment, M, is approximately that of a uniformly loaded, partly continuous beam, or M equals $Ph_s/10$, in which P equals the total pressure load on the span in pounds per foot

of width, as represented by the areas of the trapezoids between the respective wales in Fig. 1. For example, for Span 2,

$$P = phh_1 + \frac{ph_1^2}{2}$$

WALE SPACING FOR EQUAL MOMENTS IN ALL SPANS

After the maximum safe top span, h, is determined by either Equation 3 or 4, the spacing for all the lower wales —h_1, h_2, $h_3 \ldots h_x$—bears a fixed relation to h if there is to be equal stress on the sheet piling in all spans. Factors have been derived by which h is multiplied for all the lower spans, as given in Table I. The derivation of one of these factors for the case when a wale is at the top, Fig. 1 (*a*), follows. All other factors are derived by the same method. Let the increment of pressure, p, be unity, because it is the same for all spans.

$$M \text{ (top span)} = 0.1283\,\frac{h^3}{2} \text{ ft-lb}$$

$$M \text{ (span } h_1) = \frac{\left[h\,h_1 + \left(\frac{h_1}{2}\right)^2\right] h_1}{10} \text{ ft-lb}$$

By equating these moments, $2hh_1^2 + h_1^3 = 1.283\,h^3$
Solving by trial, $h_1 = 0.691\,h$

TABLE I. RELATION OF WALE SPACINGS FOR EQUAL BENDING MOMENTS IN SHEET PILING

WALE AT TOP Fig. 4 (*a*)	CANTILEVER TOP Fig. 4 (*b*)
$h_1 = 0.691\,h$	$h_1 = 1.046\,h$
$h_2 = 0.570\,h$	$h_2 = 0.823\,h$
$h_3 = 0.505\,h$	$h_3 = 0.718\,h$
$h_4 = 0.463\,h$	$h_4 = 0.653\,h$
$h_5 = 0.432\,h$	$h_5 = 0.606\,h$
$h_6 = 0.408\,h$	$h_6 = 0.570\,h$
$h_7 = 0.388\,h$	$h_7 = 0.541\,h$
$h_8 = 0.372\,h$	$h_8 = 0.518\,h$
$h_9 = 0.358\,h$	$h_9 = 0.498\,h$
$h_{10} = 0.346\,h$	$h_{10} = 0.481\,h$

Table I is based on the condition that the increment, p, of actual pressure is the same throughout the depth of the cofferdam. In practice, however, the increment often changes. For example, when a cofferdam is built in water, p increases from the hydrostatic pressure of 62.4 lb per cu ft to the pressure of the submerged earth, 75 lb per cu ft or over, at the elevation of the bottom of the water, provided of course that the inside of the cofferdam is excavated below this elevation. The maximum safe spans below this level can be determined by trial, using $M_{max} = \frac{P_x\,h_x}{10}$ with M_{max} known in the sheet piling.

Another method is to divide the intensity of the pressure at the wale, h ft below the surface, at or nearest above the elevation where the increment of pressure changes, by the new increment of pressure, p'. This will give a theoretical depth, h', developing the same intensity of pressure for the new increment, p'. Then determine a new basic h by Equation 3 or 4, for p'; and apply the factors in Table I for all the remaining spans below the wale in question. However, to be approximately accurate, the elevation of the wale h ft below the actual surface, for the first increment, must come close to the elevation h' ft below the theoretical surface for the second increment, in order that the two wales may have approximately equal intensities of pressure.

Spacing the wales to utilize the full beam strength of the sheet piling in every span results in the least number of rows of wales for a given depth and sheet-pile section. However, even for sheet piles of low beam strength, the loads on the lower wales become so heavy that timber of the necessary size is either not available, is too expensive, or occupies too much space within the cofferdam to be practical. In this case steel I-beam wales must be used, and even these become very heavy for sheet piles of high beam strength. For this reason, sheet piles having the deepest arch web are not always the best selection for a cofferdam.

CALCULATION OF WALE LOADS

For calculating the horizontal load on the wales, the following approximate method is used. By reference to Fig. 1, the load on the top wale, in pounds per lineal foot of wale, is: for wale at top, $\frac{ph^2}{6}$, and for cantilever top, $\frac{ph^2}{2} + \frac{phh_1}{2} + \frac{ph_1^2}{6}$.

The loads on the second wale for the two cases are, respectively, $\frac{ph^2}{3} + \frac{phh_1}{2} + \frac{ph_1^2}{6}$ and $\frac{phh_1}{2} + \frac{ph_1^2}{3} + p\left(\frac{h + h_1}{2}\right) h_2 + \frac{ph_2^2}{6}$.

By the same method the approximate load on any other wale may be determined; that is, by taking half the areas of the rectangles above and below the wale, two-thirds of the area of the triangle above the wale, and one-third of the area of the triangle below. However, in Span 1 of the cantilever type, the top wale of course carried approximately the total load, as represented by the triangle.

SYMBOLS DEFINED

p_e	= increment of active liquid pressure of soil, in pounds per square foot
p_w	= same for water
p_{comb}	= same for combined water and submerged soil
p	= any of the increments of active pressure, whichever applies under the conditions
p_p	= increment of net passive liquid weight of the soil
$h, h_1, h_2, h_3, \ldots h_x$	= heights in feet
S	= section modulus per foot of width of sheet pile, in inches cubed
f	= safe working stress in steel, in pounds per square inch
M	= bending moment in foot pounds per foot of width
P	= total pressure load on the span, in pounds per foot of width
x	= penetration of sheet piling, in feet below bottom of cofferdam
y	= distance below bottom of cofferdam of an equivalent simple beam, in feet
P_e	= reaction at y feet below bottom of cofferdam, in pounds per foot of width

WALE SPACING FOR EQUAL LOADS ON ALL WALES

Very often it is advantageous to space all the wales, except the top one, so that the horizontal load on each will be the same. Then wales of the same sized timbers of I-beams, including the struts, can be used throughout the cofferdam. If the sheet piling is stressed to the limit in the first span, h, this span is calculated either by Equation 3 or 4. For the special case where the maximum wale load is limited, the method outlined later is used. The remaining spans are then calculated as in a

fixed ratio to the first span, so that all the wales, except the top one, will be the same size. This method is similar in principle to that for calculating for equal stresses in all spans of the sheet piling.

The method of deriving these ratios for equal horizontal loading of the wales is illustrated in Fig. 2, using the case of the wale at the top. The pressure, p, can be assumed to be unity. First x is calculated, the altitude of a triangle having one-third the area of the larger triangle between first and second wales. The smaller triangle represents the load on the top wale.

Then, from Fig. 2, $\frac{x^2}{2} = \frac{h^2}{6}$. Solving, $x = 0.5774\ h$, which makes $x_1 = 0.4226\ h$.

The second wale is located at the center of area of the trapezoid, A, y ft above its base. Then

$$y = \frac{(y + 0.4226\ h)\ (h + y + 1.1548\ h)}{3\ (h + y + 0.5774\ h)}$$

Solving, $y = 0.3247\ h$, and $h + y = 1.3247\ h$.
For the trapezoid B,

$$\left(\frac{1.3247\ h + 1.3247\ h + z}{2}\right) z = \frac{0.5744\ h + 1.3247\ h}{2}\ (0.4226\ h + 0.3247\ h)$$

$$2.6494\ h\ z + z^2 = 1.4214\ h^2$$

$$z = 0.4575\ h$$

$$\text{Now, } \frac{y_1}{z} = \frac{x_1}{x_1 + y} = \frac{0.4226\ h}{(0.4226 + 0.3247)h} = 0.5655$$

Therefore:

$$y_1 = 0.4575\ h \times 0.5655 = 0.2587\ h$$

$$h_1 = 0.3247\ h + 0.2587\ h = 0.5834\ h$$

Table II is derived for all other spaces by the same method.

TABLE II. WALE SPACING FACTORS FOR EQUAL LOADS ON ALL WALES EXCEPT THE TOP ONE

WALE AT TOP Fig. 1 (*a*)	CANTILEVER TOP Fig. 1 (*b*)
$h_1 = 0.583\ h$	$h_1 = 0.828\ h$
$h_2 = 0.404\ h$	$h_2 = 0.539\ h$
$h_3 = 0.334\ h$	$h_3 = 0.436\ h$
$h_4 = 0.291\ h$	$h_4 = 0.372\ h$
$h_5 = 0.261\ h$	$h_5 = 0.336\ h$
$h_6 = 0.239\ h$	$h_6 = 0.307\ h$
$h_7 = 0.222\ h$	$h_7 = 0.284\ h$
$h_8 = 0.208\ h$	$h_8 = 0.265\ h$
$h_9 = 0.196\ h$	$h_9 = 0.250\ h$
$h_{10} = 0.186\ h$	$h_{10} = 0.237\ h$

When the increment, p, changes, the wale spans below can be determined by trial, or the same method can be pursued as outlined in connection with wale spacing for equal bending moments.

It sometimes happens that only a given size of waling is available, having a maximum safe load capacity of L lb per lin ft. For this case, the maximum safe span for the sheet piles, h, must be calculated so as not to exceed the safe load on the wale. The span, h, must of course not exceed the maximum safe load for the sheet piling, as determined by Equations 3 and 4.

For the case of a wale at the top, the load on the second wale is:

$$\frac{ph^2}{3} + \frac{phh_1}{2} + \frac{ph_1^2}{6} = L$$

From Table II, $h_1 = 0.583\ h$. Substituting and solving,

$$h = \sqrt{\frac{L}{0.722\ p}} \quad \ldots\ldots\ldots\ldots\ [5]$$

For a cantilever top section,

$$\frac{ph^2}{2} + \frac{phh_1}{2} + \frac{ph_1^2}{6} = L, \text{ and } h_1 = 0.828\ h$$

$$h = \sqrt{\frac{L}{1.028\ p}} \quad \ldots\ldots\ldots\ldots\ [6]$$

When all the remaining spaces have been determined from Table II, the loads on all wales, except the top one, will be approximately the same, and the safe capacity of the wales will not be exceeded.

DETERMINING NECESSARY PENETRATION

Most cofferdam failures have been due to the sheet piling being too short and not driven sufficiently far below the bottom of the cofferdam. The sheet piling either "blows in" at the bottom because of insufficient support by the soil, or the bottom "blows up" as a result of the flow of water from below. The least difficulty that will be encountered due to insufficient penetration of piling will be excessive leakage, which will require expensive pumping. It is evident that enough penetration in the soil must be obtained to support the loads on the sheet piling below the bottom wale and to prevent excessive percolation of water under the sheeting into the cofferdam.

Of vital importance in this connection is the fact that the critical condition at the bottom may occur before the cofferdam is fully unwatered. Failures have occurred at various stages of this procedure. The condition is especially dangerous in sandy or silty soils where even a small amount of percolating water

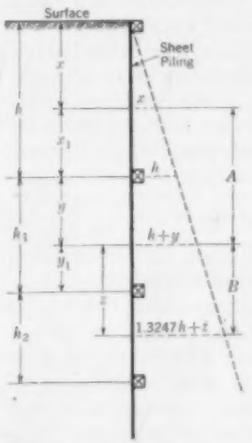


FIG. 2. WALE SPACING FOR EQUAL LOADS ON ALL WALES

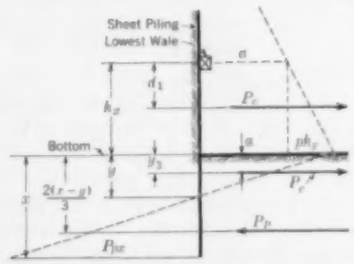


FIG. 3. FORCES ACTING ON STEEL SHEET PILING AT BOTTOM OF COFFERDAM

carries the finer particles of soil inside and thus very quickly allows more water, with increasing velocity, to flow through. Heavier particles of soil are next carried in and the leakage increases cumulatively.

To develop the full constraining action in the earth, the necessary penetration may be computed by the formula:

$$x = K\left(y + \sqrt{\frac{6\ P_c}{2\ p_p}}\right) \quad \ldots\ldots\ldots\ [7]$$

in which K ranges between 1.1 and 1.2. This equation was derived as Equation 8 in the article by Mr. Pennoyer, "Design of Steel Sheet-Piling Bulkheads," in the November 1933 issue of CIVIL ENGINEERING, and as

Equation 95 on page 888 of the August 1934 PROCEEDINGS, in Mr. Pennoyer's discussion of the paper, "Analysis of Sheet-Pile Bulkheads," by Paul C Baumann, M. Am. Soc. C.E. If constraining action is not necessary, the minimum safe penetration can be calculated by equating the moments around the bottom wale, as illustrated in Fig. 3. The total pressure loads in each area are assumed to act through the center of the areas. The distance, d_1, below the wale of the line of action of P_s is:

$$d_1 = \frac{3a\,h_s + 2\,ph_s^2}{6\,a + ph_s}$$

a being p times the distance of the bottom wale below the surface, or the intensity of pressure at that elevation.

Often it is advantageous to design the sheet piling with a cantilever section above the top wale, especially when the supporting value of the bottom is doubtful and when the cofferdam requires but one wale. The cantilever section reduces the load on the sheeting at the bottom because the wale acts as a fulcrum, and it might even be possible for the bottom of the sheeting to exert an outward pressure.

It is evident that sufficient penetration must be secured to prevent excessive flow of water under the sheet piling and a "blow-up" of the bottom. The weight of a unit column of earth inside the cofferdam must be more than the hydrostatic uplift on it and, to repeat, the weight of the submerged earth is often the critical consideration while the cofferdam is being unwatered.

The authors have not attempted to study the penetration necessary to prevent excessive seepage of water by the application of the various formulas on rate of percolation. The decision as to proper penetration has been and still is a matter of judgment and experience. For hard, impervious clay, the penetration may be as low as 15 per cent of the depth of the cofferdam, or of the unbalanced hydrostatic head. For water-bearing sand, 30 to 40 per cent is generally the rule; for silt, from 50 to 60 per cent; and for clear gravel, from 80 to 100 per cent.

SELECTION OF THE SHEET-PILE SECTION

In selecting the proper sheet pile for a cofferdam, two things should be considered, its weight and its section modulus. If the driving is to be difficult, that is through hard gravel, boulders, or soft rock strata, a heavy section with extra rugged interlock should be chosen. This is especially true if the piling is to be pulled and redriven several times. "Construction" sections with medium depth of arch and section modulus have been especially designed for such work, and are available. Sections with a deeper arch web, while perhaps more efficient theoretically, cannot be driven so certainly into hard materials.

High beam strength, or section modulus, in the sheet piling reduces the number of wales required for the same depth of cofferdam. As a rule, and in spite of the heavier weight, it is always more economical to reduce the number of rows of wales and bracing to a minimum by using a sheet pile of the highest beam strength available. This rule holds true even though it requires steel wales to carry the load, because the use of bracing is expensive, slows up the work, and cramps the working space. If, however, the pile of higher beam strength does not reduce the bracing that would be needed with a pile of less beam strength and lighter weight, the correct choice is obviously the latter provided it is sufficiently rugged to drive and that no other considerations govern the choice.

Very often there is one critical span in which it is necessary to keep the distance between braces at a maximum for clearance. For such a condition a sheet pile of the highest available beam strength is required, regardless of the weight. Generally, if the supporting value of the soil is doubtful, if the sheet pile is on rock with no support at the toe, or if it is necessary to pour a footing of a given thickness clear of all bracing, then this governing

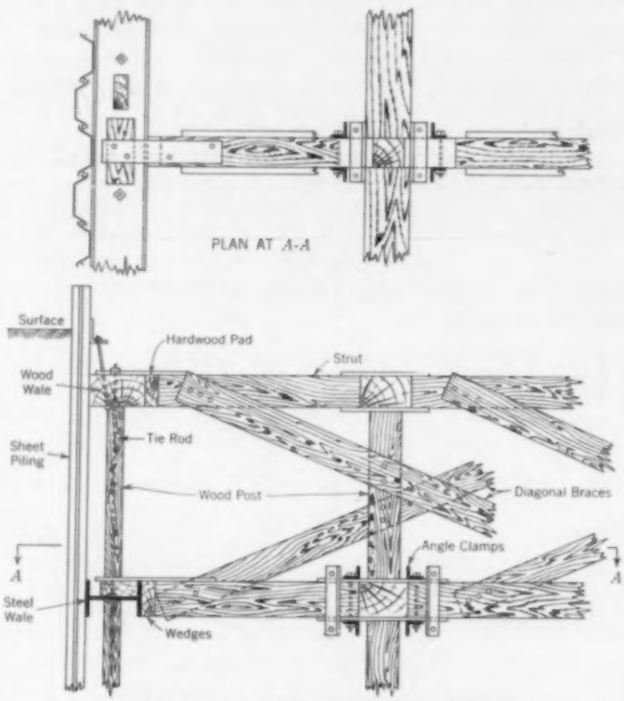


FIG. 4. FRAMING FOR WOOD AND STEEL BRACING

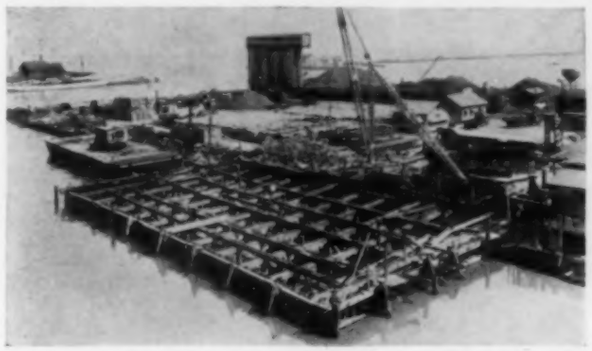
span is at the bottom of a cofferdam. In these cases it is not generally practical to space the other wales so that the full beam strength of the pile is utilized.

In Fig. 4 is shown the essential features of typical cofferdam bracing. Struts of course should be spaced so as not to exceed the beam strength of the wales. The minimum practical center-to-center distance for clearance is about 8 ft. The usual span ranges from 8 to 12 ft. All bracing must be supported and trussed by means of diagonal members, tie rods, and posts to act as a unit, including attachment to the sheet piling to hold it in position.

For work in water 20 ft deep or over, three sets of wales are set up, cross braced, and trussed together. The unit is then floated out and sunk into position; the sheet piling is driven around the frame; and excavation is commenced inside, before unwatering, to a depth of 6 or 8 ft. Another row of wales is constructed on top of the frame and the whole driven down into position. If in driving, the sheet piling is "running off" the vertical, the cofferdam should be excavated 5 or 6 ft, then unwatered and a row of wales installed underneath the frame. In this case, as in all bracing of cofferdams, blocks, jacks, and wedges should be on hand during the unwatering, and all bracing should be wedged tightly against the sheeting. Movement of the sheeting must be prevented because if the earth wedge on the outside is allowed to slide, or even break its cohesion along the plane of rupture, lateral pressures are enormously increased. It is best to wedge or jack the bracing sufficiently tight to develop some of the passive resistance of the outside soil.

The wale acts as a beam, uniformly loaded between the struts, the total load on the span being the load per foot times the distance between struts. Struts act as columns and carry the total load on one span between them.

Recommended formulas for the calculation of safe loads on wood are published by the Forest Products Laboratory of the U. S. Forest Service. Tables III and IV have been derived from these formulas for the safe



STEEL SHEET-PILE COFFERDAM FOR A BRIDGE PIER
Internally Braced with Timbers

loads on southern yellow pine, select grade, occasionally wet. The table for beams is used in arriving at the size of the wooden wales and the spacing of the struts. For the struts the column table is used. It should be kept in mind that the struts may receive blows from a grab bucket or from materials being lowered into the excavation, or their strength may be impaired by the attachment of concrete forms or the storage of tools. On this account their size should be increased over that required to carry the wale loads alone.

TABLE III. SAFE LOADS, IN KIPS, ON SQUARE WOODEN BEAMS UNIFORMLY LOADED

For Southern Yellow Pine, Occasionally Wet

SPAN In ft	SIDE OF SQUARE, IN INCHES						
	8	10	12	14	16	18	20
	9.4						
9	8.8						
10	7.9	14.7					
11	7.2	14.0					
12	6.6	12.8	21.1				
13	6.1	11.8	20.5				
14	5.6	11.0	19.0	28.7			
15	5.3	10.3	17.7	28.2			
16		9.6	16.6	26.4	37.5		
17		9.1	15.6	24.8	37.1		
18		8.5	14.8	23.5	35.0	47.5	
19		8.1	14.0	22.2	33.2	47.2	
20		7.7	13.3	21.1	31.5	44.9	58.7
21		7.3	12.7	20.1	30.0	42.7	58.6
22		7.0	12.1	19.2	28.6	40.8	56.0
23		6.7	11.6	18.4	27.4	39.0	53.5
24		6.4	11.1	17.6	26.3	37.4	51.3
25		6.2	10.6	16.9	25.2	35.9	49.2

Maximum allowable stresses: 1,385 lb per sq in. in bending; 110 lb per sq in. in shear.
Maximum safe load, 4/3 area of section times the maximum unit shear.

The safe loads given in these tables are conservative and sometimes have been even doubled for the temporary stress conditions in a cofferdam. A rule of thumb, used by some, is not to have the stress on the compression end of a strut bearing against a wooden wale exceed 500 lb per sq in. Above this stress, the end of the strut begins to bury itself in the valve. Double timber valves with hardwood cushion blocks are often used.

Similar tables giving safe-beam and column loads for steel are available in handbooks. For wales it is best to choose a beam that is comparatively shallow in relation to its flange width because of the added resistance it gives to rotation and lateral deflection.

A combination of steel wales and wood struts is very often most economical and practical.

Required pumping capacity to unwater a cofferdam can be judged only by experience. Among the factors to be considered are the head of water, the penetration of the piling, and the type of bottom. As a rule it is best to have one large pump and as many smaller ones as necessary to secure what is considered adequate capacity.

TABLE IV. SAFE LOAD, IN KIPS, ON SQUARE WOODEN COLUMNS

For Southern Yellow Pine, Occasionally Wet

LENGTH In ft	SIDE OF SQUARE, IN INCHES						
	8	10	12	14	16	18	20
	68.2						
7	67.8						
8	66.9	106.5					
9	66.0	105.7	153.4				
10	65.0	104.5	153.4				
11	63.6	103.5	151.9	208.7			
12	62.0	102.3	150.5	208.2	272.6		
14	56.3	98.9	148.0	204.8	271.4	345.1	
16	48.6	93.6	144.4	202.1	267.5	342.8	426.0
18	38.7	86.2	139.4	198.2	264.2	338.6	422.8
20	31.2	75.9	131.8	192.9	259.8	335.0	418.0
22	25.9	63.1	122.3	185.0	254.5	330.2	414.0
24	21.6	53.1	109.3	175.4	247.8	325.0	409.2

Maximum allowable compression parallel to grain, 1,065 lb per sq in.

The largest capacity is needed when unwatering is commenced and until the outside pressure is developed, which closes the piling interlocks and renders them practically watertight. After unwatering is completed, a small pump, working continuously, may be sufficient. If the cofferdam is to be excavated to rock, the ends of the piles will not bear on it evenly, and leakage will result. In this case it is wise to unwater the cofferdam as far as possible and install pipes to close the holes with grout. After the grout has set for two or three days no further leakage will be encountered.

Before driving, the proper procedure generally is to set up all the piles in the cofferdam around a guide, which can very well be the top wale. The pile should then be driven in about 6-ft stages, proceeding around the cofferdam. All piles should be plumb and should be carefully driven. If the sheet piles are forced when they meet refusal the interlocks are likely to be ruptured. It is better to excavate inside and remove the obstruction. If there are external forces tending to overturn the cofferdam, such as swiftly moving water or a high bank on one side, it must be braced by batter piles on the outside or by other means.

Very excellent, specially designed extractors for sheet piles are on the market. They can be extracted also by turning a steam hammer upside down and driving against proper clamps attached to the top of the piles. For especially difficult extraction, A-frames, with 12 to 15-part tackle may have to be used. If the holes in the sheet piles tear out, a pile-puller clamp must be used. Sheet piling has been successfully extracted when concrete up to 20 ft in thickness had been poured directly against the steel. In such a case the bond is broken by driving the sheet piling slightly before the concrete has taken its permanent set.

Cofferdams should be designed conservatively and built with the utmost care. All the savings that could possibly be realized by the doubtful construction of many cofferdams would be small as compared to the loss that would result from a single accident.

U. S. Bureau of Reclamation

BOULDER DAM AND APPURTENANT WORKS DURING CONSTRUCTION
From a Point Upstream, High on the Arizona Rim of Black Canyon. Top of Forms at Elevation 1,080

Geology of Boulder and Norris Dam Sites

Major Features of the Earth's Structure at Two Great Government Storage Projects

By CHARLES P. BERKEY
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AN unusual opportunity to study at first hand a large number of the water storage projects now under construction in the United States has been afforded Dr. Berkey. On January 10, 1934, he spoke before the Metropolitan Section on the geology of these projects and his address was of such interest that he consented to prepare this article for CIVIL ENGINEERING. *In it two of the projects are considered—one on the Colorado River and the other a part of the Tennessee Valley Development. The article is of special interest because it shows how the design of each dam and the temporary structures built to facilitate construction of the dam itself have been adapted to the geologic formations found. On the Colorado River the only unsolved geologic problem appears to be the ultimate filling of the reservoir with silt. At Norris Dam the cavernous limestone formations along the ridges and divides around the reservoir may require special treatment later. Here 36-in. core holes were used in the exploratory work. Through the cooperation of engineer and geologist, a satisfactory site for each of these huge dams has been selected, and safe structures are being built on them. Photographs not otherwise credited are by the author.*

IT might well be expected that the foundations of dams, at least at places where the rock floor can be reached, would be sufficiently similar to reduce a geological statement concerning them to simple terms. As a matter of fact, no two foundations are alike, even in principle. Each requires close individual investigation and study, for making a mistake in visualizing the geologic picture is likely to cost a great deal or to endanger the public.

There are no perfect sites, if by that term is meant a site requiring no special geological study, because there are practically no places where local conditions are known in sufficient detail to meet the engineer's exacting requirements. The most important question is always whether the design and construction plan of a dam are adapted to the local physical conditions or whether some modification would be safer and more practicable. It is a mistake to assume that only the great dams or other very large structures warrant careful geological study. It is a poor geologist who cannot give advice of practical value on almost any real problem in his own field. At the same time it must be admitted that large structures of all kinds normally make more exacting demands on natural physical conditions and raise more serious questions concerning these conditions than do smaller structures.

Thus we are indebted to the large projects now under construction for bringing the geological side of a long and honorable partnership between geology and engineering into new prominence. Cooperative study by the engineer and the geologist is not new by any means, but it has attained better standing in recent years because of a rediscovery of its importance.

No more difficult engineering undertakings of their kind have ever been attempted than the large dams now under construction in the United States. All have been given more detailed geological study than usual and thus furnish an exceptional opportunity to evaluate such service. Boulder Dam on the Colorado River and Norris Dam in the Tennessee Valley are of peculiar interest because of the advance that has been made in the actual construction.

FOUNDATION OF BOULDER DAM

Boulder Dam is located in Black Canyon, one of several short gorges cut by the Colorado River below

BOTTOM OF INNER GORGE

Side Ledges Completely Close the Gorge, Proving Absence of Crushed Zone or Fault in the Bottom

U. S. Bureau of Reclamation

EDGE OF INNER GORGE AT TOE OF DAM

Showing the 600-Ft Bench, the Bedding of the Rock Structure, and the Fluting of the Nearly Vertical Wall of the Inner Gorge

POTHOLE REMNANTS, IN INNER GORGE

Outer Walls of Three Large Potholes Eroded Away; Stratified Sands and Gravel Fill the Remaining Holes

the Grand Canyon. The site of this structure was chosen wholly on the basis of its geologic features. It was decided that at this place the rock, which consisted chiefly of reworked and indurated volcanic fragments, was sound enough, tough enough, and free enough from weaknesses to carry successfully the proposed dam and related structures. From the beginning it was realized that it would be necessary to drive extremely large diversion tunnels in the canyon walls, parallel to the river, and that conditions unfavorable to that requirement would throw doubt on the whole venture. It was fully realized, also, that a detailed investigation in the bottom of the gorge was not practicable and that the few exploratory borings successfully put down did not wholly eliminate the possibility of weaknesses in the floor that might have escaped detection.

It was apparent that during excavation the quality and behavior of the river fill, which was more than 100 ft in total depth, might present special dangers and extraordinary difficulties since the river waters might enter in such volume as to make it almost impossible to handle the ground successfully. In addition, there was the possibility that, before construction had proceeded far enough to avoid the danger, an abnormal rise of the river might destroy the uncompleted work.

However, none of these potential difficulties developed, and the unusual demands for sound rock and stable conditions have been fully met. It would be difficult to find a site where the requirements in these respects have been as perfectly fulfilled by the local physical conditions and behavior of the ground as at Boulder Dam. Four 50-ft tunnels, with a total combined length of 16,000 ft, were driven without special support. Then from 115 to 120 ft of river gravels and sands were excavated without causing a single dangerous condition from slumping, raveling, or the heavy inflow of water. The whole river was diverted into the tunnels of the canyon walls without furnishing enough leakage or seepage into the excavation to give a day's trouble. Such fine conditions and excellent behavior can seldom be provided for even a less exacting piece of work, and it is specially fortunate that the greatest dam yet undertaken should have been located so successfully.

As a matter of fact, the site was selected from a long list of alternatives distributed through two canyons 20 miles apart. In Boulder Canyon, the upper one, the rock is granite, but the walls are much jointed and cut through by many planes of weakness along which movement has formerly taken place, and the gorge itself, as shown by borings, is somewhat deeper and wider than that at the site finally selected in the other canyon. From a strictly physical viewpoint, Black Canyon was considered the better. At the site in the latter that was finally approved, the water-laid, crudely bedded deposits, made up largely of volcanic fragments, have been so well consolidated by the reorganization of the fine interstitial matter between the larger fragments that the whole mass now forms an unusually tough and durable rock. Although the rock is cut through by many small slips and an occasional crush zone representing former deformation, it was found that a dam could be located so as to avoid all such weaknesses of consequence. Furthermore, there is no local evidence of recent movement of sufficient magnitude to be registered in the canyon at this site.

GEOLOGICAL BACKGROUND OF COLORADO RIVER

A brief glance at the geologic background of the location will help toward a better understanding of it. After leaving the Grand Canyon country, the Colorado River flows through a succession of short canyons, across local mountain masses of igneous and other crystalline rocks, alternating with open valley country where comparatively friable and easily eroded sediments occupy the intervening depressions. Thus there were many

possible dam and reservoir sites on the Lower Colorado. The difficulty was not to find a site, but to find the best site within the limits set for the project and to be sure that it would accomplish its purpose.

Geologists versed in the history of the region say that in prehistoric times the Colorado and its tributaries eroded a series of valleys to much greater depth than is apparent today, and that these deeper and wider valleys were then dammed and choked with volcanic debris and

U. S. Bureau of Reclamation

ERODED SURFACE OF THE 600-FT BENCH, NEVADA SIDE
Also Notched Edge of Abrupt Drop to Gorge 75 Ft Below

U. S. Bureau of Reclamation

PLANK FOUND IN GRAVEL 50 FT BELOW LOW RIVER LEVEL
Evidently River Fill Has Been Turned Over to This Depth

back-filled with sediment to such a depth that even the mountain divides were largely covered. On this fill the river wandered quite uncontrolled by former topographic features and thus began anew the process of erosion, which it has continued to the present day. However, it flowed without any sense of its former direction and became established in a new course that lay across buried mountain masses and ancient valleys. Thus it has cut deep, narrow gorges across the rediscovered mountain masses and has re-excavated on a comparatively large scale parts of the ancient sediment-filled valleys. So there is now the succession of canyons and open country that has already been mentioned. Boulder and Black canyons form two of these trenches across former divides. However, they are not similar in any other respect.

The geologist is always specially concerned when the results of excavation are revealed. When the floor is finally laid bare, there is no more room for conjecture concerning it. Geologic facts become evident, and the person who has been responsible for giving advice is fortunate if the facts agree with his prediction. Furthermore, it is as important to check up carefully when the excavation stage is reached as it is to make judgments in the beginning. In this way more reliable criteria are established, more valuable experience is obtained, and sometimes new features of consequence are revealed.

At Boulder Dam the advisers had to depend a great deal on judgment and opinion. Since certain conditions could not be fully explored, they had to rely on geologic principles that have become more or less fully established as a part of the science. Much of their advice depended on confidence in their own observation and faith in the reliability of geologic principles as now understood.

It was, therefore, with considerable concern that geologists heard the first rumors about the floor. A deep notch had been uncovered, and the floor appeared to be honeycombed with holes. Engineers wondered whether the foundations were as weak as the first view of the excavation suggested, in short, whether a fault had been found in the floor of the dam site, or whether some other still more obscure condition had to be met.

It was known before excavation, of course, that the original borings showed a notch in the profile of the floor. Although this feature commonly suggests a weakness, it had not been considered of major importance because of other observations. Nevertheless it was an immense relief, on making the required inspection, to discover that the rock was as sound as the average of the canyon and that no fault or other special weakness was accountable for the questionable-looking features.

The whole adverse effect was produced by pothole erosion. The swirling waters of the river itself had provided the power for boring multitudes of these holes in the mid-section of the gorge, where they were deepened and enlarged until an inner gorge, more than 50 ft deeper than the average floor, was carved out. The many potholes and curious flutings gave some reason for the belief that the rock was damaged. On the contrary, the rock itself is in reality as sound and substantial, and as suitable for foundation service as it is elsewhere in the canyon. After the usual shallow excavation to remove the smaller irregularities, it became an eminently suitable foundation for the dam.

There was still greater uncertainty in the beginning concerning the condition and probable behavior of the river fill. No one could predict with full assurance what would happen when these gravels and sands were excavated. The case could be argued only on principles, and the matter had to be left to the judgment of advisers whose opinion was in general favorable. Nevertheless, their advice was somewhat discounted in that overliberal engineering estimate was made for the cost of this part of the work.

It was a special satisfaction, therefore, when the excavation was finally made, to find that the rock deposits were essentially tight and remarkably stable, extending with almost precipitous walls 30 or 40 ft into the air without any considerable amount of raveling or slumping, and not much seepage water. It was apparent from the structure and condition of the crudely stratified deposits of gravel and sand that, in every great flood, the river disturbs them to a surprising depth in the gorge. This reworking of the material extends to the bench levels, where a plank was found buried in the river fill, indicating that the deposit had been turned over to that depth at least, in very recent time. Probably the deeper inner part of the gorge is not disturbed in ordinary floods,

but the fact that the deposit is virtually free from cementation and the general similarity of the fill from top to bottom argue for occasional disturbance to full depth.

These three features just described—the substantial canyon walls, the sound rock floor, and the stable river fill—are the most important attributes of the site, and each has contributed materially to the success of the undertaking.

Usually causes for worry are over when a dam is built. However, this is not so in the case of Boulder Dam, where in certain respects trouble has only begun. When the reservoir is filled its waters will flood large salt deposits in the Virgin Valley. It is fair to question what this will do to the impounded water. Also the waters coming into the reservoir carry great quantities of silt, which will settle in the basin. It may well be asked what effect this will have on the reserve capacities of the reservoir, and how long it will be before the reservoir is filled with these deposits. Those who use the waters below the dam hope that the silt will be completely removed, for it now costs more than a million dollars a year in the Imperial Valley alone to handle that part which reaches the valley. In view of the fact that after leaving the dam the river flows two or three hundred miles through silt-filled channels, it is pertinent to ask whether it will become loaded again and be as troublesome as ever.

The Colorado finally flows into Mexican territory. For this reason Mexico claims extensive rights to its waters, and the canals now in use involve agreements between the United States and Mexico for the division of the water entering the system. The principal canal crosses Mexican territory for nearly 50 miles, because this route was by far the easiest to follow. In the hope of avoiding new claims to a share in the impounded water now provided, it is proposed to construct another canal, to be called the All-American Canal, just above the international boundary line. Among the difficulties encountered in this project will be a range of hills and a belt of drifting sand dunes several miles wide. It will be impossible to construct a canal on American territory without conquering these two obstructing features. Can this belt of moving sand be traversed successfully, or will the canal in crossing it become loaded with so much sediment that its purpose is nullified?

All these problems have their geologic background, and successful solution seems to be assured in all of them except that of the impounded silt in the reservoir. There is no help for that problem, and no answer but one. The silt will ultimately fill the whole reservoir, which will mean that the storage capacity of the structure for water will be largely destroyed. The stream will still flow across the impounded silts and will still turn the turbines and produce power, but regulation of this power will have to come from some other establishment, farther upstream, that is operated in part for this purpose.

How long will this silting of the reservoir take? Although no one knows the answer to that question, it is certain that it will take only a very short time, geologically speaking. In fact, historically speaking, it will not take long—probably not more than 200 years. Therefore it can readily be seen that the time is coming when the whole river will be marked by a succession of dams and reservoirs, developed one after another so as to put off the final evil day when there are no more dam sites to conquer on the Colorado. The engineer of that day will have to invent some other solution of the water-supply and power problems of the Colorado River country, and that situation will introduce a new era.

THE SITE OF NORRIS DAM ON THE CLINCH RIVER

Passing now to an entirely different locality, attention is directed to the Norris Dam on the Clinch River, a tributary of the Tennessee above Knoxville. It is here, near the entrance of Cove Creek that the largest structure of the Tennessee Valley Authority development is now under construction. This dam, 300 ft high, will impound an enormous volume of water, thus helping to control the flow from the watershed for a series of works located farther down the main valley.

The geologic elements in this development are comparatively simple, but they introduce problems of construction and of the subsequent behavior of the structure under operation that demand special consideration. The region is one of ancient sedimentary and organic rocks, most of which are closely folded and faulted. Because of differences in resistance, erosion has developed in these long folds and narrow fault blocks a series of nearly parallel ridges and valleys. However, this topographic character is lost along the west side of the basin where a great mass of younger strata, lying almost flat and little disturbed in any way, form the adjacent Cumberland Plateau. The waters to be impounded in Norris Dam come from both kinds of terrain, but the dam and reservoir are located in country with rock folds and strata distributed in parallel formation, where the beveled edges of strata form long belts extending northeast and southwest across the district.

Although the geologic structure of the region includes a series of sandstones and shales as well as limestones and dolomites, the most important rock in the immediate vicinity of the dam is chiefly of carbonate composition, known as the Knox Dolomite formation. Overlying beds of comparatively pure limestone occur at certain low divides on the margins of the reservoir, where their

Differential Weathering of Dolomite

Solution Cavern, Right Abutment

A Dolomite Cavern Put to Practical Use

GEOLOGIC FORMATIONS AT AND NEAR NORRIS DAM

somewhat greater solubility presents additional problems.

The rock structure at the dam is comparatively simple. Although it has been deformed, the general bedding is not greatly disturbed and the dip is downstream at a low angle. The internal structure exhibits small displacements, internal strain effects, rather abundant jointing, and related small fracturing. But it is neither closely folded nor much faulted at the dam. The formation is plainly, although somewhat unevenly bedded, and subsequent transformation of the original simple deposits has made this bedding even less regular than it was in the beginning.

Tennessee Valley Authority

NORRIS DAM ON CLINCH RIVER, NOVEMBER 1934
Cableway Towers High on Opposite Bank

A long period of erosion has developed the present topography by removing literally thousands of feet of material overlying this formation and so these strata have been exposed for ages to the action of the elements. These weathering processes have been responsible for the formation of numerous sinkholes and an extremely uneven rock floor covered with a heavy residuary soil mantle. In addition, there is an associated subsurface development of solution channels and cavernous structures of rather far-reaching and erratic connections. These follow chiefly the joints and bedding planes of the rock, which constituted the original lines along which water could circulate. Thus there has come to be a veritable network of such enlarged solution channels, now more or less completely clogged with residuary earth material.

Although the average rock is undoubtedly sound and substantial enough to support successfully a dam of the proposed proportions, several questions of major consequence arise. These may be formulated as follows:

1. Will the local sinkholes and related formations cause excessive leakage through the abutments and the reservoir margins?
2. Is there important deeper and more roundabout water circulation through enlarged joints and bedding planes, and how is it possible to check losses through these channels, especially in the immediate foundation and abutments of the dam?
3. Since the bedding is prominent and the dip is downstream, what assurance is there that the dam will not slide, and what can be done to assure its general stability?

The nature and quality of the foundation rock are easily determined, but it is not possible to discover exactly what the conditions are with respect to the cavernous structure, related water circulation, and general permeability of the formation. It is possible to satisfy all demands for stability by carrying the excavation for the dam through certain thin surface beds. By this means contact has been established with the more massive members of the formation beneath, which are competent in themselves to carry the weight and thrusts of the dam. That requirement has been met beyond any reasonable doubt.

It has been shown also by exploratory methods and a trial program of grouting that under-circulation along the bedding planes can be effectively checked and that dangers from that source can be removed by grouting. In carrying out the investigation of this particular matter, borings of "manhole" size, large enough for direct inspection purposes, were employed for almost the first time. These take the place of ordinary test shafts and are immensely superior. In fact, they doubtless constitute the most perfect method for examination of the actual condition of subsurface rock formations that has ever been invented.

Almost every important condition at the dam has been met. There is one exception for which provision cannot be made fully at this stage of construction. This is the cavernous structure of the side ground of the more distant abutments and of the narrow divides and low saddles around the reservoir. There is virtually no possibility of determining these conditions in sufficient detail to cure all leakage troubles at this time. In consequence, when the reservoir is put into service, it is certain to leak. Nevertheless, it is equally certain that whatever leakage occurs cannot endanger the dam. There is a surplus of water, and the major objective is temporary impounding of the natural flow. This will be done, and such leakage as may develop cannot destroy the general success of the project. Furthermore, after the dam is put into operation and some of the defects now hidden are revealed it will be practicable to remedy them by means of special treatment. The virtual certainty of the need of such treatment suggests that some provision be made for continuation of a grouting program through two or three years of service.

Ingersoll-Rand

HUGE CORES TAKEN FROM THE NORRIS DAM SITE
These 36-In. Borings Are of Manhole Size

From these descriptions one can see that even the uncertainties and problems that will remain after the dams are built at Cove Creek and at Boulder Canyon, are not in the same field of geologic concern. In one case the chief problems come from the fact that there is not enough water, and what there is, is loaded with trouble in the form of silt. In the other case, where there is plenty of water, the chief question is how to control leakage. No matter whether much or little can be done to solve these problems, it is surely fortunate that at Boulder Dam, where there is too little water, there is no threat of loss, while at Norris Dam, where control of leakage is a large task, there is an abundant supply. After all, despite the imposed difficulties, Nature has been kind enough to provide good rock to one, and an abundance of water to the other—in each case where those factors can help most.

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain practical or ingenious suggestions from engineers both young and old, should prove helpful in the solution of many troublesome problems.

Safety Primers Used on Construction of Colorado River Aqueduct Tunnels

By T. W. Osgood, Assoc. M. Am. Soc. C.E.

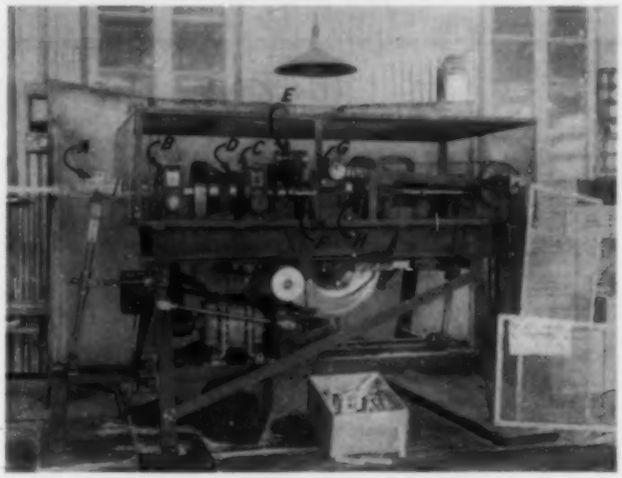
Safety Engineer, Metropolitan Water District of Southern California, Banning, Calif.

A DISTINCT step forward in improving safety conditions on the Colorado River Aqueduct was taken by the Metropolitan Water District of Southern California when it adopted safety primers for use in all blasting operations on the Coachella Division. Certain of the contractors have also put this device in use on other divisions of the aqueduct. The safety primer consists of an electric blasting cap inserted and glued in a longitudinal hole bored through a wooden plug.

An automatic machine for the manufacture of the wooden primer plugs (Fig. 1) was designed and constructed by District forces. It has a capacity of 4,500 plugs per 8-hr shift. The sequence of operations in this machine is as follows: one-inch white pine stock is fed in, and its edges are simultaneously dressed by a knife-head; the stock reaches the end of its trip and is secured by a chuck; the drill, with bevel knife-head welded to the shank, advances, drilling and beveling the plug, the drill recedes; two saws descend simultaneously, one cutting a slot in the beveled end and one cutting off the plug to the proper length; the chuck releases the plug, which drops into a box while the saws ascend; and the stock is fed forward and the operations are repeated.

For some years the Phelps Dodge Corporation, Morenci Branch, Morenci, Ariz., has used safety primers in mining operations. Data received from that source provided the basis for the development of this device to meet conditions on the Colorado River Aqueduct. On this construction from May 30 to December 31, 1934, approximately 225,000 safety primers were used in blasting at tunnel headings.

Great care has been taken thoroughly to familiarize superintendents, foremen, shift bosses, and miners with the adopted methods of loading rounds. Satisfactory results have attended the use of these primers. Their superior safety, as compared with dynamite primers, is obvious. Experience indicates that the safety primer will detonate successfully if the instructions for making primers, loading holes, and connecting up are followed. There have been very few missed holes—no more than occur when dynamite primers are used.



Machine for Making Safety-Primer Plugs

(A) Automatic Feed
(B, C) Roller Guides
(D) Knife-Head for Dressing Edges
(E) Cut-Off Saw
(F) Chuck
(G) Slotting Saw
(H) Drill and Bevel Knife-Head

From the standpoint of safety there are four main advantages of safety primers, as follows:

1. Dynamite and primers are separated until loading operations are begun. This eliminates hazards incident to: (*a*) the making of dynamite primers in the primer house; (*b*) the transportation of dynamite primers from primer house to headings; and (*c*) the handling of dynamite primers.

2. In loading the drill holes, hazards due to the following causes are eliminated: (*a*) improperly made dynamite primers in which electric blasting caps are too close to the side of the primer shell, with the possibility that the cap may come in contact with the side of the drill hole and be exploded by friction; and (*b*) jamming of the dynamite primer in a ravelling hole and forcing of blasting cap against the side of the hole with the loading stick.

3. Hazards caused by the presence of dynamite primers in the muck pile are eliminated. Safety primers in muck piles present little or no hazard when struck by the mucking machine dipper or other tools.

4. An increased feeling of security on the part of underground supervisors and men.

From the viewpoint of the construc-

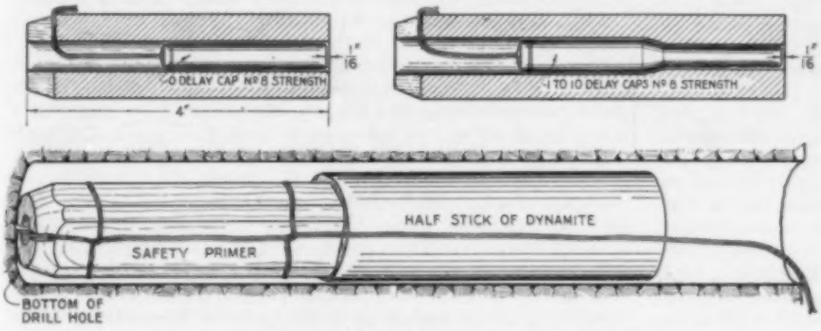


Fig. 1. Safety Primer Now in Use on the Construction of the Colorado River Aqueduct

tion forces the advantages of safety primers are as follows:

1. They are very inexpensive, especially when made in quantity.
2. They are easier and quicker to make than are dynamite primers.
3. They act as efficiently in blasting as do dynamite primers.

Although safety primers have been employed heretofore in mines, their adoption in the Coachella Division is the first time that such a device has been used in tunneling operations. This is a step forward in improving safety conditions in this class of work. Blasting accidents, although low in frequency, are very high in severity and therefore every possible safeguard to prevent their occurrence is justified.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Garbage Disposal in Los Angeles

TO THE EDITOR: I should like to comment on a few features of the Los Angeles refuse problem that were not covered in detail in the article on "Municipal Refuse Problems and Procedures," by Messrs. Reinke and Gillespie, in the September issue.

In Table I is shown the average production of garbage and non-combustible rubbish for each month of the year as a percentage of the average of all months, after adjustment for long-term growth and for the number of days in the month.

TABLE I. AMOUNTS COLLECTED IN PER CENT OF MEAN QUANTITIES

MONTH	GARBAGE	NON-COMBUSTIBLE RUBBISH	MONTH	GARBAGE	NON-COMBUSTIBLE RUBBISH
Jan.	89.5	104.9	July	116.3	94.3
Feb.	93.3	110.0	Aug.	114.3	93.1
Mar.	95.0	108.2	Sept.	107.0	95.6
Apr.	94.8	103.1	Oct.	98.6	96.5
May	89.8	100.4	Nov.	91.8	91.0
June	100.9	96.6	Dec.	92.0	91.8

The quantities per capita also vary with the purchasing power of the population. Furthermore, the relation between the quantities of per capita production of garbage and non-combustible rubbish seems to reflect variations in the ratio of the price of fresh vegetables to that of canned food. Another feature that has been especially noticeable since 1923 is the rapid increase in the production of non-combustible rubbish on a per capita basis and the relatively stationary figures for per capita garbage production. This indicates an increase in the general use of canned food during the period from 1923 to the present. The quantities also vary slowly with changes in dietetic habits and of course respond instantly and directly to increases in the population served.

Since Los Angeles disposes of its garbage by feeding to hogs, the quality of the garbage in respect to its food value for the production of pork is a matter of great importance, as it affects the profits of that business and consequently the contract renewal prices for collection and disposal. It is interesting to observe on a quantitative basis the gradual reduction, during the current depression, in the food value of garbage. The depression has affected the purchasing power and therefore the economical instincts of the housewife in the matter of discarding food. To a small degree the quality of garbage from restaurants has also been affected. The data in Tables II and III are furnished through the courtesy of A. B. Miller, president of the Fontana Farms Company, which has a contract for the disposal of the greater part of the garbage from the city of Los Angeles. The figures are percentages by weight after dehydration to about 25 per cent of original weight. The balance not reported in the table is mostly moisture.

TABLE II. VARIATION IN QUALITY OF GARBAGE IN PER CENT

YEAR	SOURCE	PROTEIN	FAT	FIBER	ASH	CARBOHYDRATES
1921	Restaurant	19.50	12.70	12.09	11.63	32.73
1927	Restaurant	18.03	24.69	7.92	12.84	28.80
1927	Restaurant	18.18	23.58	11.40	13.89	29.52
1932	Restaurant	16.68	19.44	12.84	10.02	34.41
1921	Household	11.86	20.98	12.75	13.81	35.21
1927	Household	14.43	18.96	8.67	10.89	33.09
1927	Household	12.03	13.05	9.39	23.73	27.18
1932	Household	11.04	11.10	9.45	5.85	37.35
1932	Household	10.65	12.72	11.94	12.18	35.37

The effect of the variation in quality shown in Table II has a distinct effect on the amount of pork produced, as seen in Table III.

TABLE III. EFFECT OF VARIATION IN QUALITY OF GARBAGE ON PRODUCTION OF PORK

YEAR	POUNDS OF PORK PRODUCED PER TON OF GARBAGE FED	YEAR	POUNDS OF PORK PRODUCED PER TON OF GARBAGE FED
1923	68.90	1929	54.07
1924	54.73	1930	51.75
1925	64.44	1931	39.70
1926	60.25	1932	38.53
1927	58.26	1933	38.40
1928	55.18		

Los Angeles, which collects refuse at the curb, has for years followed the custom of using mule teams with a one-man crew for close-in level areas, and a large truck and three-man crew for the remainder of the city. Recent experiments with small 1½-ton trucks and a two-man crew show economies in collection costs amounting to 30 per cent as against mule teams, and of 15 per cent as against large trucks. The mule teams are now being displaced by small trucks.

HERMAN P. CORTELYOU, M. Am. Soc. C.E.
Deputy Engineer, City of Los Angeles
Los Angeles, Calif.
December 1, 1934

Studies for Cofferdams at Bonneville

TO THE EDITOR: The article by Major Williams on "Power and Navigation Below the Snake River," is very interesting. Both the power house and the spillway dam at Bonneville are to be constructed within unwatered cofferdams having large areas, and the foundation excavation within must be carried to maximum depths of 100 ft or more below water surfaces outside. These conditions and the diversion of the flow of the mighty Columbia result in an unusual cofferdam and diversion problem.

In the planning of this work, two classes of floods must be considered: the summer peaks having a mean crest of 600,000 cu ft per sec corresponding to a stage of 30 ft above low water, and winter floods which may be expected to reach a stage of 17 ft, with a discharge of 300,000 cu ft per sec. Cofferdams are made high enough to exclude the latter only.

Under natural conditions the main channel carries the flow until the discharge is over 100,000 cu ft per sec. For floods of from 300,000 to 600,000 cu ft per sec, the flows down the auxiliary channel in which the power house is located are, under natural conditions, 40,000 and 130,000 cu ft per sec, respectively. It was therefore a simple matter to divert the river from the auxiliary channel and to keep it diverted during ordinary summer floods. This was done by the construction of coffers of the earth-dam

type. Crib cofferdams for the main channel must, however, be placed in swift water. The diversion capacity of the auxiliary channel is limited, and although it would be possible to enlarge this channel, it was found to be uneconomical. Thus it is desirable to carry the greater part of the flow in one-half the main channel while the other half is closed for construction.

On account of the unprecedented nature of the work and the risk of partial cofferdam loss from floods, ice, or blowout, it was decided that the United States should assume responsibility for cofferdams, except during the period of construction and placing. This meant that the engineers had to make a careful study of the problem. Incident to these studies, accurate cross sections of the river channels were made, water surface profiles for various flows were drawn, and the division of flow between the two channels was metered. Complete hydraulic calculations of all the diversion conditions and features were made and are being checked in a hydraulic model that has been constructed for this and other purposes. A feature of the main channel cofferdams is a removable top, about 10 ft high, which can be left in place, if it is advantageous to protect an enclosure during a summer flood.

Borings were made in the river bed at cofferdam sites for determining the permeability of material, and the permeability of banks is investigated by test pits. In the main channel the feasibility of using steel piles to penetrate the gravel and boulder formation overlying bedrock was tested, and it was also found by test that steel piles would penetrate this formation enough to cut off leakage under the cribs that will rest on it. Material from river banks where cofferdams connect was tested under various heads for percolation in a conventional tank, and percolation tests were made also by pumping from test pits.

Records of ground-water levels obtained from test pits and drill holes around the unwatered power-house area have been recorded daily. The quantity of inflow is being subdivided in so far as practicable to show its source, and it is planned by a further study of such factors as the material through which seepage occurs, records of ground-water levels, and inflow to add materially to existing data on this subject.

C. I. GRIMM, M. Am. Soc. C.E.
Chief Engineer, Bonneville Dam Section

Portland, Ore.
November 19, 1934

Central Valley Project Important

TO THE EDITOR: The Central Valley Project of California, described by Mr. Hyatt in the September issue, is intended primarily to rescue from impending aridity 400,000 acres of farm lands, at present irrigated largely by failing ground-water supplies. This area supports 300,000 people and has a gross annual crop production of $20,000,000. Irrigation of this region is therefore as distinctly a humane measure as is the protection of the Lower Mississippi farmers from floods. Since the immediate expansion of newly reclaimed areas in the state is generally opposed, the proposed program of the project is limited at present to the furnishing of adequate water supply for relief. However, it is so designed that it may be expanded in the future as required to meet the demands of the increased population indicated by the rapid development of the state in the past.

Engineers and economists, in collaboration with the U. S. Reclamation Service, have studied the project intensively over a period of 13 years and have approved it. Their reports have received the highest commendation from the chief engineer of the War Department. The adaptability of the lands in question to the production of high-priced crops and the support of a large population has been demonstrated. The Central Valley Project, which has been undertaken to sustain established communities rather than to reclaim desert lands, has been approved by a general vote of the state. The estimated total cost of the project is $170,000,000. Of this the War Department proposes to contribute $12,000,000 because of benefits to navigation, the state has requested a PWA grant of $37,000,000, and an enabling act provides that the remainder will be secured by contract from the sale of water and power, on which basis the project has been presented to the Federal authorities for a loan.

It has been contended that California has already received relatively substantial Federal aid for several major projects and is not now in line for such further assistance. However, all the large California projects aided by the Government—such as Boulder Dam and the power line therefrom, the developments of the Metropolitan Water and Imperial Irrigation districts, and the Trans-Bay Bridge—have been on the basis of loans secured by firm contracts amply providing interest rates greater than the cost of money to the Government. On the other hand, many projects outside the state have been financed by the administration or Congress without such provision for the return of the money advanced. These loans include $325,000,000 for the Lower Mississippi levees, $110,000,000 for the Tennessee Valley Authority (first stage), $86,000,000 for the Fort Peck Dam, $63,000,000 for the Grand Coulee Dam (first stage), and $32,000,000 for Bonneville Dam.

It is proposed that 63 per cent of the cost of the Central Valley Project is to be a loan secured by contract before money is advanced. From the standpoint of benefit to home owners and industry as well as to the nation at large, the project is important and, as compared with the other developments referred to, its adoption as a full Federal project is logical.

J. B. LIPPINCOTT, M. Am. Soc. C.E.
Consulting Hydraulic Engineer

Los Angeles, Calif.
November 30, 1934

More Engineering Terms Defined

DEAR SIR: The history of certain engineering terms by Professor Kirby, in the October issue, is most engaging. The article closes with several provocative questions that prompt me to add a few notes to the discussion.

His statement that STARLING is a word of unknown ancestry is surprising, since the *Oxford New English Dictionary*—to which he has obviously referred—goes into its etymology with some thoroughness, listing as alternative spellings *steerling, stirling,* and *sterling,* and remarking that the word is possibly a corruption of *staddling* (a staddle being a prop or crutch). In 1684 Defoe spoke of "the Piles or Starlings. . . . placed before the solid Stonework of London-bridge." Going back in time, we find that in 1482 "grete and many inconvenients" had been caused to the "stadelinges (starlings) of the brigge (bridge) by petermen (fishermen)." In the same text, we read that in 1461 certain fishermen were fined "for fishing next the stadelynges."

SPANDREL, another word that defies Professor Kirby's search, is traced back to the year 1477 in the form *spaundrell;* and the *New English Dictionary* suggests that it may be a diminutive of the French *espandre,* to expand or extend. The *Standard Dictionary* offers an ingenious, though rather dubious, explanation by stating that the term comes from the Old French *explander,* level, which in turn was derived from the Latin *ex,* out, and *planus,* level.

Professor Kirby seems to be in error in assigning the meaning of WELD, as we now use the word, to Wyclif's fourteenth century translation of Isaiah "Thei shulen welle togidere her swerdes" (They shall weld together their swords). The noted reformer probably used *weld together* to mean liquefy and recast. This definition seems to be borne out by the *New English Dictionary,* which gives the first use of weld, in the sense of *join,* a century or so later.

The origins of the terms KING-POST and QUEEN-POST are indeed obscure although a ray of light emerges from Tredgold's *Principles of Carpentry* wherein he speaks of "king posts (sometimes called crown posts)." From this parenthetical note we may infer that the post located at the apex or crown of a truss was first called a crown-post, later becoming a king-post; and as for the queen-post, that probably derived its name from its similarity to, and association with, the king-post.

The temptation to expand Professor Kirby's list of words is strong, but I will content myself with one addition, that of TURNPIKE. This word, common in the eastern part of the United States, is an elliptical term for *turnpike-road,* the turnpike being a horizontal pole, or pike, that barred access to a toll division of a highway. When the traveler paid his toll, the pike was turned about a vertical axis, and swung clear of the road.

EDWARD W. BENES, Assoc. M. Am. Soc. C.E.

Mount Vernon, N.Y.
November 28, 1934

Combating Water Problems in California

TO THE EDITOR: In the September issue of CIVIL ENGINEERING, Mr. Hyatt has outlined concisely the project for the conservation of water resources in the Sacramento-San Joaquin Basin. This project is an outstanding example of adequate planning for river improvement in the combined interest of practically all the established uses of water. Also it is noteworthy because, in planning it, there was full cooperation between the various Federal and state agencies concerned, which meant that practically no unnecessary expense was incurred through duplication of effort.

The U. S. War Department, through the Corps of Engineers, was in a favorable position to cooperate in the preparation of the Central Valley Project, since the river and harbor act approved on January 21, 1927, directed that comprehensive investigations and surveys be made on practically all the navigable streams of the country, including the Sacramento, San Joaquin, and Kern rivers. The purpose of such surveys was stated to be the formulation of the best plan for the improvement of these streams in the interests of navigation, flood control, power development, and irrigation.

In spite of the unsatisfactory navigation conditions caused by the demands of irrigation, water-borne commerce on the upper Sacramento River amounts to about 180,000 tons per year. Due to water shortage, there has been no commercial navigation to amount to anything on the upper San Joaquin River for some years, but this waterway still constitutes an important potential artery of commerce. It is estimated that the average annual commerce for the upper Sacramento and San Joaquin rivers, after completion of the Central Valley Project, will amount to about 600,000 tons for each stream, with a saving in transportation costs of from 45 to 55 cents per ton.

There are about 1,500,000 acres of agricultural land subject to overflow in the Central Valley of California. For the Sacramento Basin a joint Federal and state flood control project has been adopted and practically completed. This project, by means of levees, by-passes, and channel enlargement, already affords a fair degree of protection. Existing flood control works in the San Joaquin Basin, which have been constructed entirely by local interests, afford protection against floods of considerable magnitude. They consist mainly of more or less independent levee systems. On the Calaveras River one dam for flood control has been built by the city of Stockton. A number of reservoirs on the upper San Joaquin and its principal east-side tributaries, which were built primarily to furnish water for irrigation, power, and municipal use, have a material effect in reducing flood discharges.

Additional flood protection by reservoirs is desirable in the Sacramento Basin in order to ensure the safety of this highly developed region. In the San Joaquin Basin, however, additional protection by reservoirs is not so important at this time because the greater part of the areas still subject to overflow is grass land not yet developed.

The investigations and surveys made to determine the feasibility of a salt water barrier, or dam with locks, located somewhere below the common mouth of the Sacramento and San Joaquin rivers, were very complete. Although a considerable quantity of fresh water can be saved by use of the proposed barrier, for many years to come it will be cheaper to control salinity through construction of foothill reservoirs.

A full discussion of the project, from the standpoint of the U. S. War Department, will be found in the reports printed in House Document No. 191, 73d Congress, 2d Session, and Document No. 35, Committee on Rivers and Harbors, House of Representatives, U. S. 73d Congress, 2d Session.

THOMAS M. ROBINS
Lt-Col. Corps of Engineers, U. S. Army
Portland, Ore.
December 3, 1934

Humic Compounds in Los Angeles Harbor District Wells

TO THE EDITOR: In connection with the article by Messrs. Wade and Brown, in the September issue, it may be of interest to comment on the fact that the Department of Water and Power of the City of Los Angeles has had considerable trouble with humic compounds present in the underground supply in the Wilmington and San Pedro areas. In general these waters, whether free of color or highly colored, are soft, are devoid of sulfates, and are laden with marsh and other gases. They contain humic compounds and bacterial growth of the iron and sulfur types, and have a high pH value, high oxygen demand, and a high oxygen consumed content. Any disturbance of equilibrium in the water as withdrawn from the ground permits bacterial growths to increase, and a lowering of the pH value causes the humic compounds to be attacked or precipitated, as the case may be, forming an odorous brown, black, or white sludge, depending on whether there is ferric, ferrous, or no iron present. The yellow color of some of the well waters and of the water standing in service pipes appears to be due to the presence of organically bound iron, which is difficult to recover by the standard methods of water analysis of the American Public Health Association.

Waters in which the bacterial food consists of these humic compounds, or where a drop in pH value is suffered, soon deteriorate in the distribution system. Sludge is formed even overnight, although it readily flushes out when consumers start to use water in the morning. The cost of flushing to help relieve these troubles has been excessive.

At Wilmington, where the raw water has a color varying from 55 to 125 ppm, the problem was met by constructing a 5-mgd filtration plant and using ferric chloride as a coagulant. This effectively removes the humic substances present in the raw water. There is nothing unusual about this plant except that diffused air is needed in the first mixing chamber to remove gas so that the floc can settle later. It has a mixing time of 30 min, a settling period of 1 hr, and standard filtration equipment. At a load of 5 mgd the ferric chloride dose is 2 g per gal, which reduces the color to 13 ppm.

The department has two other supplies in the harbor area at Lomita. One is a group of wells yielding very highly colored water, which at the present time is an emergency supply and which causes trouble when used. The other is a group of three wells having a raw color less than that of the treated water at Wilmington, and it is this group that has given the greatest trouble. Without treatment the bacterial count is over 100,000 per cu cm and complaints increase with a rise in the count. When 20 lb of chlorine and 7 lb of ammonia per million gallons are used, the count is kept below 50,000. However, this treatment does not entirely prevent the water from "spoiling" in the lines feeding reservoirs or in the distribution system directly. The delivered water had a slight musty odor and occasional particles of white filamentous growths. It was found that water treated in this manner and allowed to settle in reservoirs remained good when it was pumped into other reservoirs.

In an effort to keep growth in pipes at a minimum, copper sulfate was used. This was successful so far as lines from wells to pump sumps were concerned, but its use led to disastrous results further on in the system. Apparently the sulfate content of the copper was quickly acted on by sulfate-splitting organisms which produced sulfides. These, in turn, reacted with iron to form ferric sulfide. The water and its sludge then became black and caused the most serious complaints ever made in the harbor area. Copper chloride has now been substituted for copper sulfate.

Our experience is that by far the most troublesome constituents in Pacific Coast waters are the humic compounds.

R. F. GOUDEY, Assoc. M. Am. Soc. C.E.
Sanitary Engineer, Department of Water and Power
Los Angeles, Calif.
November 27, 1934

Eighty-Second Annual Meeting

New York, N.Y., January 16-19, 1934—Program of Sessions, Entertainment, and Trips

Business Meeting, Prize Awards, and Committee Reports

WEDNESDAY—January 16, 1935—Morning

AUDITORIUM

9:00 Registration

10:00 Eighty-second Annual Meeting called to order by

HARRISON P. EDDY, *President, American Society of Civil Engineers; Consulting Engineer*, Boston, Mass.

10:10 Report of the Board of Direction
Report of the Secretary
Report of the Treasurer

10:40 Conferring of Honorary Membership

W. L. DARLING, *M. Am. Soc. C.E., Consulting Engineer*, St. Paul, Minn. Mr. Darling will be presented to the President by JOHN F. STEVENS, *Past-President and Hon. M. Am. Soc. C.E.*, Baltimore, Md.

The late MILO S. KETCHUM, *M. Am. Soc. C.E.; Consulting Engineer; Dean, College of Engineering, and Director, Engineering Experiment Station, Emeritus, University of Illinois*, Urbana, Ill. Statement on the achievements of Dean Ketchum will be made by HERBERT S. CROCKER, *Past-President, Am. Soc. C.E.; Consulting Engineer*, Denver, Colo.

ROBERT RIDGWAY, *Past-President, Am. Soc. C.E.*, New York, N. Y. Mr. Ridgway will be presented to the President by CHARLES F. LOWETH, *Past-President, Am. Soc. C.E.; Chief Engineer, Chicago, Milwaukee, St. Paul and Pacific Railroad*, Chicago, Ill.

11:00 Presentation of Society Medals and Prizes

The Norman Medal to LEON S. MOISSEIFF, *M. Am. Soc. C.E.; Consulting Engineer*, New York, N. Y., for Paper No. 1821, "George Washington Bridge—Design of the Towers."

The J. James R. Croes Medal to H. M. WESTER-WESTERGAARD, *M. Am. Soc. C.E.; Professor, Theoretical and Applied Mechanics, University of Illinois*, Urbana, Ill., for paper No. 1835, "Water Pressures on Dams During Earthquakes."

The Thomas Fitch Rowland Prize to MILES I. KILLMER, *M. Am. Soc. C.E.; Manager, Mason and Hanger Company, Inc.*, New York, N.Y., for Paper No. 1841, "Fulton Street, East River Tunnels, New York, N.Y."

The James Laurie Prize to E. WARREN BOWDEN, *M. Am. Soc. C.E.; Assistant to Chief Engineer, The Port of New York Authority*, New York, N.Y., and H. R. SEELY, *Assoc. M. Am. Soc. C.E.; Resident Engineer, Central Section, George Washington Bridge, for Port of New York Authority*, Fort Lee, N.J., for Paper No. 1823, "George Washington Bridge—Construction of the Steel Superstructure."

The Arthur M. Wellington Prize to J. C. EVANS, *Esq., Terminal Engineer, The Port of New York Authority*, New York, N.Y., for Paper No. 1825, "George Washington Bridge—Approaches and Highway Connections."

The Collingwood Prize for Juniors to G. H. HICKOX, *Jun. Am. Soc. C.E.; Associate, Mechanical Engineering, University of California*, Berkeley, Calif., and G. O. WESSENAUER, *Jun. Am. Soc. C.E.; Assistant Engineer, West Virginia Power and Transmission Company*, Pittsburgh, Pa., for Paper No. 1854, "Application of Duration Curves to Hydro-Electric Studies."

11:15 Presentation of Reports of Committees

COMMITTEE ON CONCRETE AND REINFORCED CONCRETE ARCHES
CLYDE T. MORRIS, *M. Am. Soc. C.E.; Professor of Structural Engineering, Ohio State University*, Columbus, Ohio, *Chairman.*

COMMITTEE ON EARTHS AND FOUNDATIONS
LAZARUS WHITE, *M. Am. Soc. C.E.; President, Spencer, White and Prentis, Inc.*, New York, N.Y., *Chairman.*

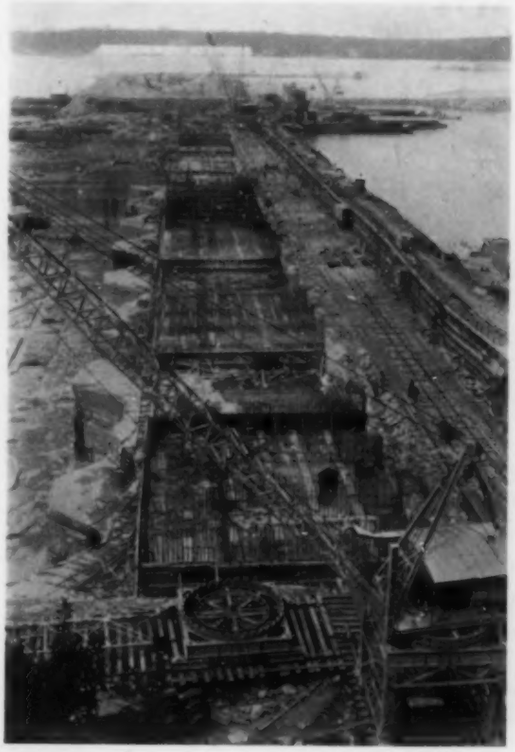
COMMITTEE ON FLOOD PROTECTION DATA
GERARD H. MATTHES, *M. Am. Soc. C.E.; Principal Engineer, Office of President, Mississippi River Commission*, Vicksburg, Miss., *Chairman.*

COMMITTEE ON HYDRAULIC RESEARCH
J. C. STEVENS, *M. Am. Soc. C.E.; Consulting Hydraulic Engineer*, Portland, Ore., *Chairman.*

12:00 New Business
Report of Tellers on Canvass of Ballot for Officers
Introduction of President-Elect

12:30 Luncheon

Fifth floor, Engineering Societies Building; tickets $1.00 each.



WHEELER DAM AND POWER HOUSE UNDER CONSTRUCTION
Navigation Lock on Opposite Side

Use Railroad Certificate to Obtain Reduced Fare. Consult Your Ticket Agent for Selling Date in Your Territory.

President's and Honorary Members' Dinner, Reception, and Dance

WEDNESDAY—January 16, 1935—Evening

Dinner and Dance Committee

E. R. NEEDLES, *Chairman,*
WILLIAM J. SHEA *and* HERBERT M. HALE

7:00 Assembly

7:30 Dinner

9:30 Reception to the President and Honorary Members

10:00 Dancing

This function will be held at the Hotel Roosevelt, Madison Avenue and 45th Street, the Grand Ballroom to open at 7:00 p.m. and the dinner to be served promptly at 7:30 p.m.

Arrangements have been made for tables seating ten persons, and members may underwrite complete tables. Orders to underwrite a table must be accompanied by check in full, and a list of guests.

The seating list will close at 5:00 p.m., Tuesday, January 15, 1935. Those who purchase tickets after 5:00 p.m., January 15, will be assigned to tables in order of their purchase. Tickets will be on sale at Society Headquarters until 5:00 p.m. Wednesday, January 16, 1935.

Tickets will be $5 each. Tickets for Juniors, for the dance only, will be $2 per couple.

Sessions of Technical Divisions Occupy a Day and a Half

WEDNESDAY—January 16, 1935—Afternoon

WATERWAYS DIVISION

2:30 The Recent and Proposed Improvements of the Cape Cod Canal

Prepared and presented by E. C. HARWOOD, *Esq., Lieutenant, Corps of Engineers, U.S.A.*, under the direction of Lieut. Col. John J. Kingman, District Engineer, U. S. Engineer's Office, Boston, Mass.

Discussion opened by

C. A. FARWELL, *M. Am. Soc. C.E.; Member Fay, Spofford and Thorndike, Consulting Engineers*, Boston, Mass.

WALTER J. DOUGLAS, *M. Am. Soc. C.E.; Consulting Engineer (Parsons, Klapp, Brinckerhoff and Douglas)*, New York, N.Y.

EUGENE L. MACDONALD, *M. Am. Soc. C.E.; Associate Engineer, Parsons, Klapp, Brinckerhoff and Douglas*, New York, N.Y.

JAMES A. WOODRUFF, *Colonel, Corps of Engineers, U.S.A. Division Engineer, North Atlantic Division*, New York, N.Y.

3:30 Increased Activities of Marine Wood Borers on the New England Coast

FRANK C. SHEPHERD, *M. Am. Soc. C.E.; Consulting Engineer, Boston and Maine Railroad*, Boston, Mass.

Discussion opened by

WILLIAM F. CLAPP, *Esq., Consulting Biologist to the New England Committee on Marine Pile Investigation*, Duxbury, Mass.

JOHN AYER, *M. Am. Soc. C.E.; Member of firm of Fay, Spofford and Thorndike, Consulting Engineers*, Boston Mass.

WILLIAM G. ATWOOD, *M. Am. Soc. C.E.; Consulting Engineer*, New York, N.Y.

SURVEYING AND MAPPING DIVISION

2:30 National Planning Compels National Mapping

FREDERICK H. MCDONALD, *M. Am. Soc. C.E.; Consulting Engineer*, Atlanta, Ga.

Discussion opened by

C. J. TILDEN, *M. Am. Soc. C.E.; Strathcona Professor of Engineering Mechanics, Yale University*, New Haven, Conn.

Proposed Systems of State Surveying and Mapping Information Bureaus

J. S. DODDS, *M. Am. Soc. C.E.; Associate Professor, Civil Engineering Department, Iowa State College*, Ames, Iowa.

Discussion opened by

HENRY J. SHERMAN, *M. Am. Soc. C.E.; Consulting Engineer New Jersey Board of Commerce and Navigation*, Camden, N.J.

TEREDO AND LIMNORIA ATTACK ON PILING IN NORTH ATLANTIC WATERS

Left, Untreated Norway Pine Pile, Portland, Me., Destroyed by Limnoria. Center, Untreated Southern Yellow Pine, Rye, N.Y., Driven in 1928, Attacked by Teredo, Removed in 1934 Right, Pile Destruction, Brightman Bridge, Fall River, Mass.

WEDNESDAY—January 16, 1935—Afternoon (Con't.)

CONSTRUCTION DIVISION—HIGHWAY DIVISION

JOINT SESSION

2:30 Highway Design and Travel Speeds

E. C. LAWTON, *Esq., Assistant Commissioner of Construction, Division of Highways, New York State Department of Public Works,* Albany, N. Y.

Discussion

Relation of Uniform Traffic Code to Highway Safety

A. B. BARBER, *M. Am. Soc. C.E.; Manager, Transportation and Communication Department, U. S. Chamber of Commerce,* Washington, D.C.

Discussion

Separation of Ways

ROBERT H. FORD, *M. Am. Soc. C.E.; Assistant Chief Engineer, Rock Island Lines,* Chicago, Ill.

Discussion opened by

BAXTER L. BROWN, *M. Am. Soc. C.E.; President, Board of Public Service of St. Louis,* St. Louis, Mo.

Safer Highways

JOSEPH J. DARCY, *Esq., Highway Department,* Babylon, L.I., N.Y.

Discussion opened by

THOMAS W. WALTON, *Esq., Henry W. Horst Company,* Philadelphia, Pa.

THURSDAY—January 17, 1935—Morning

STRUCTURAL DIVISION

10:00 Common Sense in Structural Design

(1) From the Academic Viewpoint

HARDY CROSS, *M. Am. Soc. C.E.; Professor of Structural Engineering, University of Illinois,* Urbana, Ill.

(2) From the Viewpoint of the Bridge Designer

GLENN B. WOODRUFF, *M. Am. Soc. C.E.; Engineer of Design, San Francisco Bay Bridge Commission,* San Francisco, Calif.

(3) From the Viewpoint of the Building Designer

ALBERT SMITH, *M. Am. Soc. C.E.; President, Smith and Brown, Engineers, Incorporated,* Chicago, Ill.

Discussion opened by

ALLSTON DANA, *M. Am. Soc. C.E.; Engineer of Design, The Port of New York Authority,* New York, N.Y.

FRANK A. RANDALL, *M. Am. Soc. C.E.; Structural Engineer,* Chicago, Ill.

POWER DIVISION

JOINTLY WITH HYDRAULICS DIVISION OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS

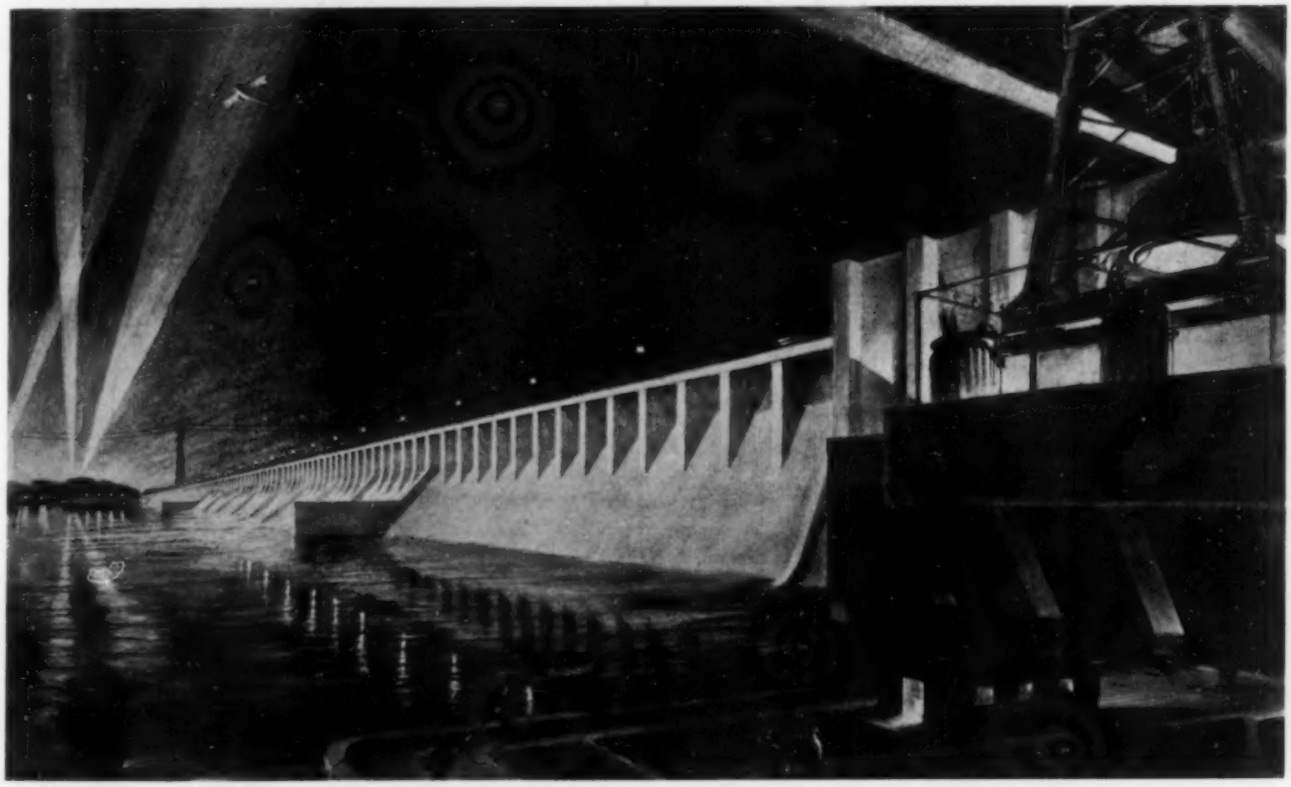
10:00 Bentzell Velocity Tube

F. H. FALKNER, *Jun. Am. Soc. C.E.; First Lieutenant, Corps of Engineers, U.S.A., Assistant Director, U.S. Waterways Experiment Station,* Vicksburg, Miss.

10:45 Pitot Tube Practice

EDWARD S. COLE, *M. Am. Soc. C.E.; Hydraulic Engineer,* New York, N.Y.

11:30 (See Next Page)



WHEELER DAM AS IT WILL LOOK WHEN COMPLETED IN 1936; FOR FLOOD CONTROL, NAVIGATION, AND POWER ON TENNESSEE RIVER

THURSDAY—January 17, 1935—Morning (Con't.)

11:30 Comparative Measurements by a Venturi Meter and a Ten-Foot Weir

C. M. ALLEN, *M. Am. Soc. C.E.; Professor of Hydraulic Engineering, Worcester Polytechnic Institute*, Worcester, Mass., and L. J. HOOPER, *Esq., Worcester Polytechnic Institute*, Worcester, Mass.

Discussion

SANITARY ENGINEERING DIVISION

10:00 Sanitary Engineering Experiences in the Operation of a Large Industrial Enterprise

A. CLINTON DECKER, *M. Am. Soc. C.E.; Sanitary Engineer, Tennessee Coal, Iron and Railroad Company*, Birmingham, Ala.

10:30 Discussion

10:40 Status of Sewage Disposal for New York City, with Special Reference to New Projects

RICHARD H. GOULD, *M. Am. Soc. C.E.; Engineer in Charge, Sewage Disposal and Intercepting Sewers, Department of Sanitation*, New York, N.Y.

11:10 Discussion

11:20 Business Session

Report of Executive Committee
Report of Committee on Papers
Report of Committee on Rudolph Hering Medal Award
Report of Committee on Salvage of Sewage
Report of Committee on Sludge Digestion
Report of Committee on Promotion of Status of Sanitary Engineering

12:00 Report of Committee on Filtering Materials: Sands for Water Filters

W. E. STANLEY, *Assoc. M. Am. Soc. C.E.; Hydraulic and Sanitary Engineer, Pearse, Greeley and Hansen*, Chicago, Ill.

12:30 Discussion of topic, "Sands for Water Filters"

12:45 Adjournment

CITY PLANNING DIVISION

10:00 Report by the Chairman of the Division

GEORGE H. HERROLD, *M. Am. Soc. C.E.; Managing Director and Engineer, The City Planning Board*, St. Paul, Minn.

10:10 Milwaukee County Park and Parkway Development, a Depression Activity

WILLIAM F. CAVANAUGH, *Assoc. M. Am. Soc. C.E.; Highway Commissioner and Planning Engineer, Milwaukee County Highway Department*, Milwaukee, Wis.

10:40 Discussion opened by

JAY DOWNER, *M. Am. Soc. C.E.; Chief Engineer, Westchester County Park Commission*, White Plains, N.Y.

10:50 Must Planning Go on the Shelf During a Depression?

RUSSELL V. BLACK, *M. Am. Soc. C.E.; City Planner*, New Hope, Pa.

11:20 Discussion opened by

ARTHUR C. COMEY, *M. Am. Soc. C.E.; Consulting City Planning Engineer*, Cambridge, Mass.

11:30 City Planning Surveys and Research with FERA Funds, an Unparalleled Opportunity

T. T. MCCROSKY, *Assoc. M. Am. Soc. C.E.; Planning Director, City Planning Commission*, Yonkers, N.Y.

11:50 Discussion opened by

HAROLD M. LEWIS, *M. Am. Soc. C.E.; Consulting Engineer; Engineer, Regional Plan Association, Inc.*, New York, N.Y.

THURSDAY—January 17, 1935—Afternoon

STRUCTURAL DIVISION

2:30 Final Report of the Committee on Concrete and Reinforced Concrete Arches

CLYDE T. MORRIS, *M. Am. Soc. C.E.; Professor of Structural Engineering, Ohio State University*, Columbus, Ohio, *Chairman*.

Discussion opened by

CHARLES S. WHITNEY, *M. Am. Soc. C.E.; Consulting Engineer*, Milwaukee, Wis.

3:30 Progress Report of the Committee on Masonry and Reinforced Concrete

HALE SUTHERLAND, *M. Am. Soc. C.E.; Professor and Head of Department of Civil Engineering, Lehigh University*, Bethlehem, Pa., *Chairman*.

4:30 The Pressure of Concrete on Forms

HARRISON G. ROBY, *M. Am. Soc. C.E.; Chief Hydraulic Engineer, Byllesby Engineering and Management Corporation*, Chicago, Ill.

POWER DIVISION

JOINTLY WITH HYDRAULICS DIVISION OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS

2:30 Engineering Design Features of Norris Dam and Power House

BARTON M. JONES, *M. Am. Soc. C.E.; Construction Engineer, Tennessee Valley Authority*, Knoxville, Tenn.
Discussion opened by LYNN J. BEVAN, *M. Am. Soc. C.E.; Consulting Engineer*, 26 Beaver Street, New York, N.Y.

3:15 Engineering Design Features of Wheeler Dam and Power House

WILFRED M. HALL, *M. Am. Soc. C.E.; Construction Engineer, Tennessee Valley Authority*, Town Creek, Ala.
Discussion opened by JOEL D. JUSTIN, *M. Am. Soc. C.E.; Consulting Engineer*, Philadelphia, Pa.

4:00 The Regulation of the Tennessee River

JAMES S. BOWMAN, *M. Am. Soc. C.E.; with Tennessee Valley Authority*, Knoxville, Tenn.

4:45 Discussion opened by

L. F. HARZA, *M. Am. Soc. C.E.; President Harza Engineering Company*, Chicago, Ill.

SANITARY ENGINEERING DIVISION

2:30 Report of Committee on Water Supply Engineering

3:00 Pre-treatment of Sewage for Grease and Oil Removal

HARRISON P. EDDY, JR., *M. Am. Soc. C.E.; Consulting Engineer*, Boston, Mass.

3:30 Discussion

3:40 Principles of Spray Drying, with Special Reference to Sewage Sludge

C. L. RILEY, *Esq., President, Vice-President and Treasurer, Clark, MacMullen and Riley, Inc.*, New York, N.Y.

4:10 Discussion

4:20 The Chemical Treatment of Sewage: Its Present Status and Possibilities

LINN H. ENSLOW, *Assoc. M. Am. Soc. C.E.; Editor, "Water Works and Sewerage,"* New York, N.Y.

4:50 Discussion

5:00 Adjournment

CITY PLANNING DIVISION

2:15 City Planning and the Problem of the Slums

MAURICE DEUTSCH, *Esq., Architect and Engineer*, New York, N.Y.

2:45 Discussion opened by

JOHN J. COSTA, *Assoc. M. Am. Soc. C.E.; Professor, Civil Engineering, Manhattan College*, New York, N.Y.

GEORGE H. HERROLD, *M. Am. Soc. C.E.; Managing Director and Engineer, The City Planning Board*, St. Paul, Minn.

3:00 The Real Property Inventory—A New Tool for the City Planner

HOWARD WHIPPLE GREEN, *M. Am. Soc. C.E.; Secretary, Cleveland Health Council*, Cleveland, Ohio.

3:30 Discussion opened by

W. W. DE BERARD, *M. Am. Soc. C.E.; Associate Editor, "Engineering News-Record,"* Chicago, Ill.

3:40 The Development of the Art of Traffic Engineering

SIDNEY J. WILLIAMS, *M. Am. Soc. C.E.; Director, Public Safety Division, National Safety Council*, Chicago, Ill.

4:10 Discussion opened by

WARREN E. DEYOUNG, *Assoc. M. Am. Soc. C.E.; District Manager, Automatic Signal Corporation*, Chicago, Ill.

4:20 General Discussion: The Relation of Local, Regional, County, and City Planning Agencies to State Planning Boards

JACOB L. CRANE, JR., *M. Am. Soc. C.E.; Consulting Engineer*, Chicago, Ill.

ARTHUR C. COMEY, *M. Am. Soc. C.E.; Consulting City Planning Engineer*, Cambridge, Mass.

GEORGE H. HERROLD, *M. Am. Soc. C.E.; Managing Director and Engineer, The City Planning Board*, St. Paul, Minn.

HAROLD M. LEWIS, *M. Am. Soc. C.E.; Consulting Engineer; Engineer, Regional Plan Association, Inc.*, New York, N.Y.

M. W. TORKELSON, *M. Am. Soc. C.E.; Director of Regional Planning, State Highway Commission*, Madison, Wis.

BOURNE HIGHWAY BRIDGE OVER CAPE COD CANAL, MASSACHUSETTS

Entertainment for the Ladies—Smoker for the Men

THURSDAY—January 17, 1935—Afternoon and Evening

FASHION SHOW AND TEA

GRAND BALLROOM, HOTEL ROOSEVELT

Committee: EMIL PRAGER, *Chairman*, and E. W. STEARNS

4:00 Fashion Show

Through the courtesy of Franklin Simon and Co. the ladies will be entertained at a Fashion Show at the Hotel Roosevelt.

5:15 Tea

Following the Fashion Show, tea will be served.

7:00 Social Evening and Bridge

At Engineering Woman's Club, Inc., 123 East 37th Street, followed by refreshments.

The Ladies Committee has planned an evening of entertainment for the ladies at the Engineering Woman's Club. Those who care for cards may also enjoy themselves at bridge.

Engineering Woman's Club

Through the courtesy of the Engineering Woman's Club, Inc., 123 East 37th Street, the facilitie of the club will be available to the ladies during the entire Annual Meeting.

All ladies are especially invited to make the Club their headquarters. Members of the Ladies Committee will be at the Club to assist visiting ladies in getting acquainted and to furnish information about shopping, sightseeing, and points of interest.

There will be an information desk for ladies at Society Headquarters. All ladies are requested to avail themselves of the facilities of the Society or the Engineering Woman's Club.

THURSDAY—January 17, 1935—Evening

ADDRESS AND SMOKER

AUDITORIUM

Committee: C. W. BRYAN, JR., *Chairman*, and E. DEV. TOMPKINS

8:00 Address by Dr. William Beebe

Members will be privileged to hear Dr. Beebe deliver an address on "Five Hundred Fathoms Down." Mr. Beebe is well known for his many scientific writings on bird life and evolution and more recently has been in the public eye for his exploration of ocean life at depths greater than half a mile. Dr. Beebe will illustrate his talk with motion pictures and lantern slides. The Society is extremely fortunate in being able to learn at first hand of his most recent deep-sea findings.

Refreshments will be served on the fifth floor beginning at 8:00 p.m., to be followed, after the address, by the usual smoker.

Tickets for the Smoker and evening's entertainment are free to members. Guest tickets are $2.00 each.

Sanitary Engineers' Annual Meeting and Dinner

TUESDAY—January 16, 1935—All Day

New York State Sewage Works Association

The New York State Sewage Works Association will hold its annual meeting on Tuesday, January 15, 1935, in the Colonial Room of the Hotel McAlpin, New York, N.Y.

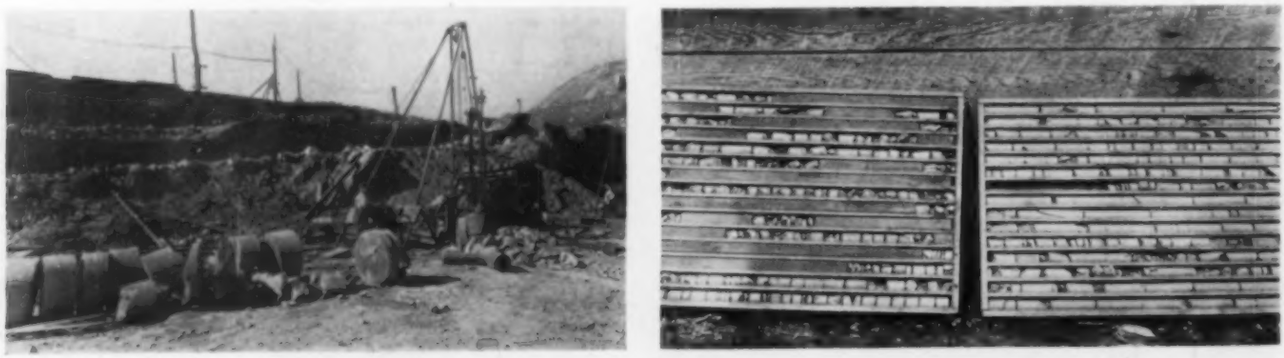
This meeting will convene at 9:00 a.m., and there will be a luncheon at 12:30 p.m. in the same rooms.

In the evening, the members will meet jointly with the Sanitary Engineering Division of the Society at its annual dinner at the Hotel McAlpin. The technical sessions will be devoted to a discussion of the operation of sewage works. Members of the Sanitary Engineering Division are urged to attend.

TUESDAY—January 16, 1935—Evening

Annual Dinner of Sanitary Engineering Division

Arrangements have been made for the Annual Dinner of the Sanitary Engineering Division of the Society on Tuesday, January 15, 1935, at 7:00 p.m., at the Hotel McAlpin, Broadway and 34th Street, New York, N.Y. Walter D. Binger, M. Am. Soc. C.E., Deputy Commissioner in charge of Engineering, will talk on the "Operations of the New York City Department of Sanitation." The charge per cover will be $2.50. Reservations should be made not later than January 14, 1935, through Richard H. Gould, M. Am. Soc. C.E., Department of Sanitation, 54 Lafayette Street, New York, N.Y.



EXPLORATORY CORES TAKEN FROM FOUNDATION OF NORRIS DAM

Left, 36-In. Drill Rig and Cores; Right, Boxes of 3-in. Cores Showing Varying Amount of Recovery from Holes

Members Are Urgently Requested to Make Early Reservations for All the Functions in Order to Facilitate the Work of the Committee in Completing Arrangements.

College Reunions Throughout the Week

Alumini Gathering Scheduled for Visiting Engineers

THURSDAY—January 17, 1935

Brown Engineering Association

On Thursday, January 17, 1935, at 12:30 o'clock, the Brown Engineering Association is holding an informal luncheon meeting in the Hotal Wentworth, 59 West 46th Street, New York, N.Y. All Brown alumni are invited. The charge will be 50 cents per cover. Please phone Mr. C. G. Burgess (Vanderbilt 3-8000) not later than noon, January 16, if you plan to attend.

Dinner of Columbia Engineers

The graduates of Columbia University who are members of the Society will meet for an informal dinner on Thursday, January 17, 1935, at 6:15 p.m., at the Columbia University Club, 4 West 43d Street, New York, N.Y. Lantern slides illustrating some of the recent research work of the Department of Civil Engineering will be shown. The charge will be $1.25 per cover. Address communications to J. K. Finch, M. Am. Soc. C.E., Columbia University, New York, N.Y.

Lafayette College Civil Engineers Dinner

All civil engineers of Lafayette College are invited to attend an informal dinner on Thursday, January 17, 1935, at 6:00 p.m., in the grill room of the Happiness Restaurant, 6 East 39th Street, New York, N.Y. The charge will be $1.10 per cover. If you plan to attend, please notify Mr. William R. Wolff, 2 Adrian Avenue, New York, N.Y.

Lehigh University Alumni Dinner

Lehigh University engineers, members of the Society, are invited to an informal dinner to be held at the Fraternity Club, 22 East 38th Street, New York, N.Y., on Thursday, January 17, 1935, at 6:00 p.m. The dinner will cost $1.75 per cover.

The facilities of the club will be available to all Lehigh men during the late afternoon and evening. Dinner will be over in time for guests to attend the Society Smoker.

Please promptly notify Alexander Potter, M. Am. Soc. C.E., 50 Church Street, New York, N.Y., if you can be present. The committee hopes for a full attendance at this dinner of Lehigh members. These annual dinners were inaugurated last year with great success, and the committee hopes that this year's dinner will be an even greater success.

Luncheon of M. I. T. Engineers

All M. I. T. Alumni are invited to a luncheon at the Technology Club of New York on Thursday, January 17, 1935, at 12:30 p.m., at the club rooms, 22 East 38th Street, New York, N.Y. Please notify the Technology Club (Caledonia 5-1475) as to attendance.

New York University Alumni Reunion Dinner

The New York University Alumni Reunion Dinner will be held at Rutley's Grill, 1440 Broadway, New York, N.Y., on Thursday evening, January 17, 1935. There will be a social gathering at 6:00 p.m., followed by dinner at 6:30 p.m. The charge will be 85 cents per cover. For information and reservation, please write Mr. William Nawrocki, Dinner Chairman, 206 Myrtle Avenue, Jersey City, N.J.

University of Illinois Engineers Dinner

All University of Illinois engineers and their friends are invited to the Seventh Annual Informal Dinner-Reunion at the Hotel Woodstock, 127 West 43d Street, New York, N.Y., on Thursday January 17, 1935, at 5:45 p.m., in the Elizabethan Grill.

The dinner will cost $1.00 and will be over in time for guests to attend the Society's Smoker. If you plan to attend, please notify James M. Hardesty, Assoc. M. Am. Soc. C.E., Bell Telephone Laboratories, Inc., 463 West Street, New York, N.Y. (phone, Chelsea, 3-1000).

University of Pennsylvania Civil Engineers Dinner

The Sixteenth Annual Informal Dinner of the University of Pennsylvania Civil Engineers will be held at the University of Pennsylvania Club, 35 East 50th Street, New York, N.Y., on Thursday, January 17, 1935, from 6:00 to 7:30 p.m. The dinner fills in the time from the end of the Technical Session at 5:00 p.m. until the commencement of the Smoker at 8:00 p.m. Dinner will be served at 6:00 p.m. sharp, in the main dining room of the club.

The charge per cover will be $1.00. Any further information can be obtained from William G. Grove, M. Am. Soc. C.E., Care, Robinson and Steinman, Room 1104, 117 Liberty Street, New York, N.Y.

Luncheon of Chi Epsilon Honorary Civil Engineering Fraternity

Members of Chi Epsilon, their families and their friends, are extended a cordial invitation to attend a very informal luncheon at the Wentworth Hotel, 59 West 46th Street, New York, N.Y., on Thursday, January 17, 1935, at 1:15 p.m.

Arrangements have been made to provide adequately for a fairly large group; but those interested should file advance notice with R. I. Land, Assoc. M. Am. Soc. C.E., 10th Floor, 100 East 42nd Street, New York, N.Y. (phone, Ashland 4-3300, Ext. 194), or H. T. Larsen, M. Am. Soc. C.E., Room 1610, Engineering Societies Building, New York, N.Y. (phone, Pennsylvania 6-9220).

The Wentworth Hotel is about ten minutes walk from the Society Building. It has excellent facilities and a much-liked cuisine. The management serves a regular luncheon for 50 cents and 75 cents, and à la carte fare is also available. It is earnestly hoped that as many Chi Epsilon members as possible, with their friends, will make it a point to remember this date.

FRIDAY—January 18, 1935

Cornell Dinner

Visiting Cornell Engineers will be granted guest cards and the privileges of the Cornell Club of New York for the period of the Convention, on application at the club, 245 Madison Avenue, New York, N.Y.

On Friday, January 18, 1935, all Cornell Engineers are invited to dine informally at 6:30 p.m. at the Cornell Club. There will be no set program or speeches.

Harvard-Yale-Princeton Joint Meeting

The Harvard Engineering Society will be the host for the coming Harvard-Yale-Princeton Huddle on the evening of Friday, January 18, 1935. Arrangements have been made with the Western Union Telegraph Company for an evening of inspection and entertainment in their new building, 60 Hudson Street, New York, N.Y.

All members of the Harvard-Yale-Princeton societies, who care to do so, may take dinner at reasonable prices in the cafeteria on the first floor of the Western Union Building. Members are invited to bring in friends who care to attend, including members of their families.

In order that the necessary arrangements can be made, please notify Mr. J. Buckley Bryan, Chairman, Meeting Committee of Harvard Engineering Society, Room 436, Empire State Building, New York, N.Y. (phone, Lackawanna 4-3600).

Thayer Society of Engineers of Dartmouth College

The annual meeting and dinner of the Thayer Society of Engineers of Dartmouth College will be held at the Dartmouth College Club, New York, N.Y., at 6:30 p.m., Friday, January 18, 1935. Notify the Dartmouth College Club, 24 East 38th Street, New York, N.Y., as to attendance.

All-Day Excursion on Friday to Roebling Company's Plants

FRIDAY—January 18, 1935—Morning and Afternoon

Excursion Committee: DAVID BONNER, *Chairman*, W. J. BARNEY and ROBERT H. JACOBS

Through the courtesy of the John A. Roebling Sons Company, members, ladies and guests of the Society will have the unusual opportunity of visiting and inspecting the huge plants at Trenton and Roebling, N.J., on Friday, January 18, 1935.

At the Trenton Plant will be seen the largest wire-cable testing machine in the world as well as the mill for manufacturing insulated electrical wire. Points of particular interest at the plant at Roebling will be the steel mill, the wire drawing mill and the wire rope mill. Visitors will be specially conducted through these mills.

After the inspection at Trenton, luncheon will be served at the Hildebrect Company of Trenton in one of the plants. The group will then proceed by special train to Roebling.

The special train will leave New York from the Pennsylvania Station at 10:15 a.m. and will arive in New York on the return trip, about 5:30 p.m. Tickets for the trip, including luncheon, are $3.00 each.

Trips to Points of Engineering Interest

SATURDAY—January 19, 1935—Morning

10:00 Inspection Trips

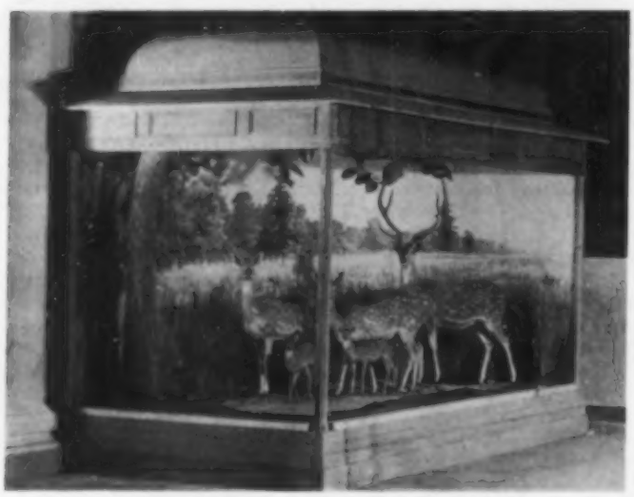
As these trips all start about the same hour, it will not be possible to participate in more than one. Members will proceed individually to the rendezvous point named for the trip selected, so as to arrive at the time given. Arrangements have been made for visits to the following points of engineering interest:

1. New York Museum of Science and Industry
2. American Museum of Natural History
3. Knickerbocker Village
4. St. John X-Ray Service, Inc.
5. Model House
6. Building Materials Exposition
7. Fabricated House Exhibit
8. Testing Laboratory, College of the City of New York
9. B.M.T. Dispatcher's Office and Shops

New York Museum of Science and Industry

220 EAST 42D STREET

Exhibits in the New York Museum of Science and Industry consist largely of industrial equipment or working models. For example, the development of marine transportation, illustrated by models from the earliest Phoenician and Greek sailing vessels up to the *Bremen*, may be seen. Railroad development is portrayed by models of locomotives, cars, and other equipment, from the earliest to the modern.



A HABITAT GROUP, MUSEUM OF NATURAL HISTORY, NEW YORK

There is also a particularly fine exhibit of aviation material, and demonstrations of the principles of flying. Other divisions illustrate the history of food industries, clothing, housing, and automotive transportation. The Museum is open from 10:00 a.m. to 5:00 p.m. and is located in the News Building at 220 East 42d Street, which is within walking distance of the Engineering Societies Building.

Members may visit the Museum at their convenience as well as on the regularly scheduled trip.

American Museum of Natural History

COLUMBUS AVENUE AND 77TH STREET

10:00. Assembly in main foyer of Museum. Guide, John Saunders.

10:05–10:15. Talk, What is the American Museum of Natural History?

10:15–10:30. Visit to the Flying Bird Hall. Here, in the oldest section of the Museum, amid cases built fifty or more years ago, is the Flying Bird Dome, a good example of modern museum practice.

10:30–11:00. Visit to Preparation Studios to See:

1. How animals and birds are prepared for exhibit.
2. Accessory materials—plants, trees, flowers artificially made that look more natural than the real thing.
3. Background painting.
4. Miniature groups. Every group is carefully modeled to scale in these small replicas of the real groups. This is the Museum's method of planning and developing a habitat group.

11:00–11:30. Visit to new African Hall, where elephants, giraffes, gorillas, and rhinoceroses are shown in their native habitats. The habitat group in the many stages of its remarkable development will be seen, including construction of the case.

11:30–12:00. The Hayden Planetarium, under construction. The first of its kind in New York City, bringing the universe under one roof and making it perform for the entertainment and education of the people of New York.

Lunch can be obtained at the Museum restaurant on the second floor at the end of the tour.

Knickerbocker Village

10 MONROE STREET

Knickerbocker Village, only recently completed, is a housing project constructed by the Fred F. French Companies in collaboration with the State Board of Housing, the Reconstruction Finance Corporation, and the Board of Estimate and Apportionment of

New York City. It is located two blocks from the East River, between the Brooklyn and Manhattan bridges, and consists of 12-story, fireproof buildings. The apartments encircle central gardens of nearly an acre each. More than half the entire five acres of the project is devoted to lawns, flowers, trees, and playgrounds.

Knickerbocker Village is within walking distance of City Hall and is accessible by way of the Second Avenue or Third Avenue Elevated as well as the subway lines to lower Manhattan. The party will assemble at the Knickerbocker Village Renting Office, 10 Monroe Street, and will be conducted over the development by representatives of the Fred F. French Companies.

St. John X-Ray Service, Inc.

LONG ISLAND CITY, N.Y.

Members taking the trip to the St. John X-Ray Service, Inc. will have demonstrated for them the equipment for a non-destructive testing of engineering materials by means of x-rays and gamma rays. A short talk will be given on the subject of non-destructive testing, which will be illustrated with photographs of field and plant installations. Exographs and gammagraphs will be shown and interpreted, with particular attention to the inspection of welded structures, concrete structures, and other materials that are of special interest to civil engineers.

On account of the limited facilities, it will be necessary to restrict the attendance at this demonstration to a total of 24 persons, 12 making the visit on Saturday morning and 12 in the afternoon, the inspections starting at 10:00 a.m. and 2:30 p.m., respectively. On account of the restriction as to number, preference will be given, therefore, to the requests of out-of-town members, as the St. John X-Ray Service will be glad to demonstrate its work on request at any other time to interested members.

The St. John X-Ray Service is at 30–20 Thomson Avenue, Long Island City, N.Y., and may be reached conveniently by the Interborough Subway, via the Queensboro Tubes to Long Island City, the destination being Court House Square Station, Long Island City.

Model House

39TH STREET AND PARK AVENUE

The Model House was erected at 39th Street and Park Avenue by the New York Committee of Better Homes in America in cooperation with the Columbia Broadcasting System. It is intended as an educational demonstration of values in house construction, interior decoration, furnishing, and small-property landscaping.

It is open for inspection from 10:00 a.m. to 5:00 p.m. every day except Sundays and Mondays, on which days the visiting hours are from 1:00 p.m. to 5:00 p.m.

Building Materials Exposition

101 PARK AVENUE

At 101 Park Avenue is the Building Materials Exposition, a permanent showing of the latest developments in building materials and mechanical equipment for private as well as commercial and industrial buildings.

Visitors are welcome at any time, but special plans have been made for the group that makes the visit on Saturday, January 19.

Fabricated House Exhibit

GRAND CENTRAL PALACE

Those interested in fabricated construction may see the exhibit of Houses, Inc., 914 Grand Central Palace, into which has gone a great deal of research into materials, architectural features, and equipment for the small home. The latest inventions in air conditioning, lighting, heating, refrigeration, and plumbing, have been utilized.

Those who may not find it convenient to make the inspection on Saturday will be welcome at any other time.

B.M.T. Dispatcher's Office and Shops

Through the courtesy of the officers of the Brooklyn Manhattan Transit Subway System (B.M.T.), members will have the opportunity of inspecting the Chief Dispatcher's Office and the car shops. Some conception of the problems of subway operation may be realized from the fact that the yearly mileage totals about 100,000,000 with approximately 25 per cent of the total passenger traffic each day concentrated into two hours, one hour at the peak of the morning rush and one hour at the peak of the evening rush.

One of the many requisites for maintaining the intensive operation required is accurate and immediate knowledge of movements of trains on every part of the system in relation to carefully prepared schedules. To accomplish this, the Chief Dispatcher's Office has a model board on which, by means of electric lights, the position of trains on the trunk lines is shown. Headway graphs show at once variations in schedule, and thus the Dispatcher's Office has visual knowledge of the movements of trains at key points of the system.

Following the inspection of the equipment and the Chief Dispatcher's Office, the group will go to the car shops at Coney Island, where a point of interest will be one of the two light-weight subway trains now in operation. One of these trains is of stainless steel, manufactured by the Budd Company, and the other is of aluminum, constructed by the Pullman Car and Manufacturing Corporation.

Members taking this inspection trip will go directly to the offices of the B.M.T. Lines, 385 Flatbush Avenue Extension, Brooklyn, N.Y., which may be reached by taking the B.M.T. Brighton or Fourth Avenue Local or the West End and Brighton Express, getting off at DeKalb Avenue, Brooklyn.

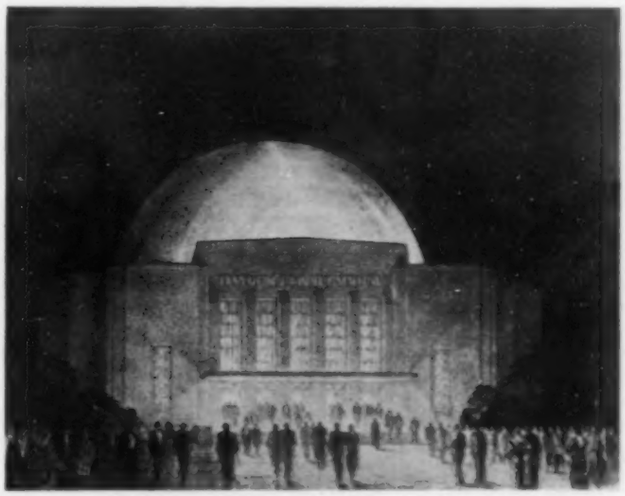
Testing Laboratory, College of the City of New York

140TH STREET AND AMSTERDAM AVENUE

Through the courtesy of the School of Technology, College of the City of New York, members of the Society are invited to witness a test to destruction of a standard steel building-frame connection. The specimen to be tested is similar to that illustrated in the paper by J. C. Rathbun, M. Am. Soc. C.E., in the January 1935 PROCEEDINGS. To demonstrate the action of steel beam connections of the shallow wind-bracing type, when the moment is reversed several times, the particular specimen to be tested was designed so that failure due to tension in the rivets might be anticipated. Before such a failure occurs it is anticipated that the rivets subjected to shear will be badly overstressed.

Provision will be made to alternate the movement on the connection from positive to negative, increasing the moment load with each alternate change until the connection fails.

The test will be run beginning at 9:00 a.m. and continue until about 5:00 p.m. To reach the college, enter the Interborough Rapid Transit Subway (I.R.T.) at Times Square and take a northbound train marked "Van Cortlandt Park." Leave the train at 137th Street Station and walk northeast to the Technology Building at 140th Street and Amsterdam Avenue.



HAYDEN PLANETARIUM, MUSEUM OF NATURAL HISTORY
Reinforced Concrete Hemispherical Dome 80 Ft in Diameter

Reduced Railroad Rates, Hotel Accommodations, and General Announcements

Reduced Railroad Rates

Reduced rates on the Identification Certificate Plan have been granted by the Passenger Associations of the United States and the lines of the Canadian Passenger Associations. A certificate authorizing purchase, at starting point, of round-trip tickets at reduced rates has been mailed to the membership of the Society.

Hotel Accommodations

In order to be certain of accommodations, members are urged to make definite arrangements for rooms at least a week in advance of the Annual Meeting, paying for the rooms in advance for at least a part of the period during which they expect to be in New York.

Special Hotel Accommodations

For the convenience of members, arrangements have been made with a first-class hotel, within 15 minutes' walking distance of Society Headquarters, for the following accommodations at an "all expense price" of $9.00 per person: for room with bath, January 15 to 18, inclusive, and breakfasts, January 16 to 19, inclusive, choice of menus.

This price includes tips to bellmen for room service on arrival and to waiters, and is based on the occupancy of each room by two persons. For single occupancy the price will be $3.00 additional.

For those who will not arrive until the morning of January 16 after breakfast, the price will be $7.50 on a two-in-room basis, or $2.25 extra for a single room.

Reservations are being held for only 100 and will be assigned in the order requested. Those interested should write at once, sending their reservations to the Secretary, American Society of Civil Engineers, 33 West 39th Street, New York, N.Y.

Hotel Rates

Hotels	Without Private Bath		With Private Bath	
	Single Room	Double Room	Single Room	Double Room
Roosevelt	.....	.....	$3.50 up	$6.00 up
Astor	$1.50 up	$3.00 up	2.50 up	3.50 up
Commodore	.....	.....	3.00 up	4.50 up
Lexington	.....	.....	3.00 up	4.00 up
McAlpin	2.00 up	3.50 up	2.50 up	4.00 up
Murray Hill	2.00 up	3.00 up	2.50 up	3.50 up
New Yorker	.....	.....	3.50 up	5.00 up
Pennsylvania	.....	.....	3.50 up	5.00 up
Plaza	.....	.....	5.00 up	7.00 up
Savoy-Plaza	.....	.....	5.00 up	7.00 up
Taft	.....	3.00 up	2.50 up	3.50 up
Vanderbilt	.....	.....	3.00 up	5.00 up
Waldorf-Astoria	.....	.....	5.00 up	8.00 up
Wellington	2.00 up	3.00 up	2.50 up	3.50 up
Woodward	.....	.....	2.50 up	3.50 up

NOTE: The Hotel Roosevelt, at which the reception, dinner, and dance will be held, will care for reservations to the extent of its capacity.

Bermuda in the Winter Time

Plans have been perfected for a short trip to Bermuda following the Annual Meeting, this voyage to be open to members and their guests at special rates on an all-expense basis. Those who take advantage of this trip will leave New York on Saturday afternoon, January 19, 1935, on the *Monarch of Bermuda*, spending Sunday at sea and arriving at Hamilton early in the morning of Monday, January 21. The party will be accommodated at the Hotel Bermudiana, and the remainder of Monday and all of Tuesday will be available for sightseeing, golf, and other diversions. Leaving Hamilton by train on Wednesday morning, January 23, for St. George, the group will have luncheon at the Hotel St. George. The voyagers will then board the same ship, *Monarch of Bermuda*, for the return trip, arriving in New York on Friday morning, January 25.

A special, all-inclusive price has been arranged for the whole trip. This includes round-trip transportation, stateroom with private bath, all meals on shipboard, room with private bath and all meals at the Hotel Bermudiana, the U. S. Government tax, rail transportation from Hamilton to St. George, luncheon at the Hotel St. George, and tender transfer to the *Monarch of Bermuda*. Those interested in this cruise should write to the Secretary of the Society promptly in order to be assured of accommodations.

Facilities of the Engineers Club to Out-of-Town Members

For the convenience of out-of-town members, the Committee has made arrangements with the Engineers Club for luncheon and dinner on Thursday, January 17, 1935. The luncheon tickets are 85 cents each and the dinner tickets are $1.25 each, and will be on sale at the Registration Desk. The Club will also be able to accommodate a limited number of members, the price of the rooms ranging from $2.50 upward. Requests for reservations should be made in advance and addressed to Society Headquarters.

Information Desk

An Information Desk is provided in the Reading Room of the Society on the Fifteenth Floor of the Engineering Societies Building to assist visiting members in obtaining hotel reservations and theater tickets, and on securing any desired information about the City. Their attention is called to the facilities of the Reading Room (open until 9:00 p.m., Tuesday, Wednesday, and Thursday evenings), for meeting friends, writing letters, and receiving mail. All members are welcome to inspect and utilize the quarters of the Society.

Introductions for Visiting Members

Members who, during their attendance at the Annual Meeting, wish introductions or meetings with engineers in New York City, may call on the Secretary's Office for any service desired.

Your New York Address

At the Registration Desk, a card file of those in attendance will be maintained, with information as to members' hotel addresses in New York. Members are requested to keep Headquarters informed as far as possible of their New York addresses so as to expedite the delivery of telegrams, telephone messages, and mail.

Order All Tickets in Advance

Members who order tickets in advance will not only be saved annoyance and delay by having tickets and badges awaiting them on arrival at Headquarters, but they will assist the Committee greatly by giving advance information to guide it in concluding arrangements. Ticket order blanks have been mailed to each member with the railroad certificate and condensed program.

No cancellation of tickets can be made after noon of Wednesday, January 16, 1935.

Committee on Local Arrangements for the Annual Meeting

WILLIAM MCK. GRIFFIN, *Chairman*
E. R. NEEDLES, *Vice-Chairman*

W. J. BARNEY	ROBERT H. JACOBS
DAVID BONNER	EMIL PRAEGER
C. W. BRYAN, JR.	WILLIAM J. SHEA
C. F. GOODRICH	E. W. STEARNS
HERBERT M. HALE	E. DEV. TOMPKINS

Ladies Committee

MRS. ARTHUR S. TUTTLE, *Honorary Chairman*
MRS. WILLIAM MCK. GRIFFIN, *Chairman*
MRS. EMIL PRAEGER, *Vice-Chairman*

MRS. W. J. BARNEY	MRS. THADDEUS MERRIMAN
MRS. DAVID BONNER	MRS. E. R. NEEDLES
MRS. C. W. BRYAN, JR.	MRS. J. P. H. PERRY
MRS. ALLAN W. CUDDEBACK	MRS. ROBERT RIDGWAY
MRS. HARRISON P. EDDY	MRS. RALPH R. RUMERY
MRS. C. F. GOODRICH	MRS. GEORGE T. SEABURY
MRS. HERBERT M. HALE	MRS. WILLIAM J. SHEA
MRS. JOHN P. HOGAN	MRS. OLE SINGSTAD
MRS. LESLIE G. HOLLERAN	MRS. JOHN R. SLATTERY
MRS. OTIS E. HOVEY	MRS. E. W. STEARNS
MRS. ROBERT H. JACOBS	MRS. E. DEV. TOMPKINS
MRS. GEORGE L. LUCAS	MRS. CHARLES E. TROUT

Please call on the Committee on Local Arrangements or on the Secretary's Office for any service desired.

SOCIETY AFFAIRS

Official and Semi-Official

1934 Prize Awards

LEON S. MOISSEIFF
Norman Medal for Paper, "George Washington Bridge—Design of the Towers"

HARALD MALCOLM WESTERGAARD
J. James R. Croes Medal for Paper, "Water Pressures on Dams During Earthquakes"

MILES I. KILLMER
Thomas Fitch Rowland Prize for Paper, "Fulton Street, East River Tunnels, New York, N.Y."

E. WARREN BOWDEN

HOMER R. SEELY
James Laurie Prize for Paper, "George Washington Bridge—Construction of the Steel Superstructure"

JOHN CARLYLE EVANS
Arthur M. Wellington Prize for Paper, "George Washington Bridge—Approaches and Highway Connections"

G. O. WESSENAUER

G. H. HICKOX
Collingwood Prize for Juniors for Paper, "Application of Duration Curves to Hydro-Electric Studies"

Award of Prizes and Medals to Be Made at Annual Meeting

AT THE Annual Meeting of the Society, to be held in New York, N.Y., January 16–19, 1935, the annual presentation of prizes and medals will take place. Of these the oldest Society prize is the Norman Medal, which dates back to 1872, when it was endowed by the late George H. Norman, M. Am. Soc. C.E. This award is made for an original paper that is considered a particularly notable contribution to engineering science. In 1912 the Society established the J. James R. Croes Medal, which is awarded for a second paper considered to be of only slightly less merit than that receiving the Norman Medal.

In 1882 the late Thomas Fitch Rowland, Hon. M. Am. Soc. C.E., endowed the prize that bears his name, to be awarded preferably for the paper which describes in detail some accomplished works of construction. A prize named in honor of the first President of the Society, the late James Laurie, M. Am. Soc. C.E., for the paper considered second in order of merit to that awarded the Thomas Fitch Rowland Prize was established by the Society in 1912.

For the best paper on some phase of transportation, the *Engineering News-Record* in 1921 established and endowed the Arthur M. Wellington Prize. Although the recipient of this prize does not have to be a member of the Society, its award rests with the Society. In 1894, on his retirement as Secretary of the Society, the late Francis Collingwood, M. Am. Soc. C.E., endowed a prize for Juniors of the Society. Papers eligible for the Collingwood Prize for Juniors must describe an engineering work or record an important investigation with which the writer has been connected. Excellence of style is a factor in the selection of the paper receiving this prize.

Biographical sketches of those who will receive prizes or medals at the Annual Meeting follow.

E. WARREN BOWDEN, M. Am. Soc. C.E., was graduated from Lehigh University in 1921, with the degree of civil engineer. The five years from August 1921 to June 1926 were spent on the construction of the Delaware River suspension bridge at Philadelphia, Pa. This period was devoted entirely to construction work in the field, including the spinning and compacting of the two 30-in. cables. From June 1926 to October 1928, he was engaged in the private practice of municipal and structural engineering and land surveying. Since October 1928, he has been associated with The Port of New York Authority, having served for the first year and a half as assistant to the engineer of construction on the George Washington Bridge across the Hudson River at New York and the Bayonne Arch across the Kill van Kull. After that he was assistant to the chief engineer on all Port Authority engineering projects. During the past year he has been jointly employed by the Port Authority and the Triborough Bridge Authority in the capacity of assistant to the chief engineer on the construction of the Midtown Hudson Tunnel and the Triborough Bridge.

JOHN CARLYLE EVANS was graduated from the University of Pennsylvania in 1905, with the degree of B.S. in C.E. In 1911 he was awarded the C.E. degree by the same university. From 1905 to 1910 he was in the bridge departments of the following railroads: the Pennsylvania Railroad (lines west of Pittsburgh); the Missouri Pacific; the St. Louis and San Francisco; the Lake Shore and Michigan Southern; the Lake Erie and Pittsburgh; and the Cleveland Short Line. From 1910 to 1926 he was with the Long Island Railroad on grade-crossing eliminations, and from 1926 to date, he has been with The Port of New York Authority in the capacity of terminal engineer.

GEORGE H. HICKOX, Jun. Am. Soc. C.E., was graduated from the University of Iowa in 1925, with the degree of bachelor of engineering in civil engineering. In 1926 he received the degree of master of science in hydraulic engineering from the same university. During 1926–1927 he taught applied mathematics at Albion College, Albion, Mich. The following year was spent with the West Penn Electric Company in Pittsburgh, Pa., on studies of hydro-electric and flood-control systems. For the next four years he was engaged on various hydraulic engineering projects, including drainage, flood-control, irrigation, and power developments, the most important being the design of the flood-control works at Dallas, Tex., by the Morgan Engineering Company. Since 1932, he has been at the University of California in the Department of Mechanical Engineering, which is actively engaged in building up its hydraulic laboratory for investigation of open-channel flow. His chief interest is the application of the fundamental laws of mechanics and thermodynamics to hydraulic problems.

MILES I. KILLMER, M. Am. Soc. C.E., was graduated from Pennsylvania State College in 1906. He received his early training in work on the Pennsylvania Railroad tunnels under the East River and on the rapid transit tunnels of the dual subway system in New York. From 1917 to 1919 he was with the 28th Engineers in France. From 1919 to 1927 he was resident engineer and, later, construction engineer on the Holland Tunnel. Since 1928 he has been manager for the Mason and Hanger Company, Inc. During the period from 1928 to 1932 this company built the Fulton Street–East River–Cranberry Street tunnels and the Rutgers Street–East River–Jay Street tunnels of the municipal subway system in New York City. At present it has the contract for the construction of the Under-River Section of the Midtown Hudson Vehicular Tunnel.

LEON S. MOISSEIFF, M. Am. Soc. C.E., studied at Columbia University, from which he was graduated in 1895 with the degree of C.E. From 1897 to 1915 he was bridge engineer and engineer of design in the Department of Bridges of the City of New York, in which capacity he was actively connected with the design of the Queensboro and Manhattan bridges the strengthening of the Williamsburg Bridge, and the design of the proposed Hudson Memorial Bridge Since 1915 he has been a consulting engineer on bridges and structures and has been consultant on the design of the Delaware River Bridge at Philadelphia, the Ambassador Bridge at Detroit, and the high-level suspension bridge at Toledo. He has been consulting engineer on the George Washington Bridge and the Bayonne (Kill van Kull) Arch and is at present a member of the Consulting Board of the Golden Gate Bridge and the San Francisco–Oakland Bay Bridge, and consulting engineer on the Tri-Borough Bridge. He has been a member of various engineering committees and has published numerous papers on bridge design and materials. He is responsible for the development and introduction of the deflection theory for suspension bridges as well as for the development of theories of the action of lateral forces in suspension bridges. These theories now have an accepted place in suspension bridge design.

HOMER R. SEELY, Assoc. M. Am. Soc. C.E., was graduated from Cornell University in 1919, with the degree of civil engineer. Following graduation, he was employed for four years by the Bethlehem Steel Company on the detailing, design, and erection of steel bridges and buildings. From July 1923 until September 1925, he was engaged on the construction of the Delaware River Bridge, designing and preparing contract drawings, and constructing the main cables and suspended steelwork. From September 1925 until February 1934, he was associated with The Port of New York Authority, at first on the preliminary design studies for the George Washington Bridge and miscellaneous work on the Arthur Kill bridges. After February 1929 he served as resident engineer on the Central Section, and later also on the New Jersey Section, of the George Washington Bridge He is now engaged on the construction of the Triborough Bridge, serving in the capacity of resident engineer of the East River crossing.

G. O. WESSENAUER, Jun. Am. Soc. C.E., was graduated from Carnegie Institute of Technology in 1927, with the degree of bachelor of science in civil engineering. After graduation he was employed by the West Virginia Power and Transmission Company, for which he was engaged in investigations of proposed hydro-electric developments in northern West Virginia, and in the preparation of data for license application to Federal and state power commissions. In 1931 he was transferred to the office of the chief engineer of the West Penn Electric Company, for which he made additional investigations of a similar nature in western Maryland, Pennsylvania, and Virginia, considering the sites particularly as to their economic justification as a power supply for a large utility company operating in a cheap fuel area. He has also been employed as part-time instructor in the department of mathematics at the Carnegie Institute of Technology.

HARALD MALCOLM WESTERGAARD, M. Am. Soc. C.E., was born on October 9, 1888, in Copenhagen, Denmark, and received a B.S. degree in civil engineering from the Royal Technical College, in Copenhagen, in 1911. He was engaged in the design of reinforced

concrete in Copenhagen, Hamburg, and London from 1911 to 1914 and studied in Göttingen in 1913 and in Munich in 1914. From 1914 to 1916 he studied at the University of Illinois, receiving the Ph.D. degree in 1916. Other degrees he has received are those of Dr. Ing. from the Technical University of Munich in 1925; Dr. Techn. (honorary), Royal Technical College in Copenhagen, 1929; and D.Sc. (honorary) from Lehigh University in 1930. He has been on the faculty of the University of Illinois since 1916, from 1927 as Professor of Theoretical and Applied Mechanics. From 1929 to 1930, while on leave of absence from the university, he was in the U. S. Bureau of Reclamation, as Senior Mathematician, dealing with the structural problems of Boulder Dam. After returning to the university, he continued this work as consulting engineer until 1932. He has written papers on structural mechanics and the theory of elasticity.

New Elections to Honorary Membership

WILLIAM L. DARLING

ALTHOUGH a native of the East and an engineer of New England training, William L. Darling is fundamentally a product of the West, where he has spent practically his entire professional lifetime. It is needless to add that the strong ties that bind him and his adopted home are mutual: the West likes Mr. Darling as whole-heartedly as he admires it, for he has had much to do with the upbuilding of this vast region.

Born at Oxford, Mass., on March 24, 1856, William L. Darling was graduated from Worcester Polytechnic Institute in 1877, receiving the degree of B.S. in civil engineering. In 1927 he was awarded the honorary degree of doctor of engineering by the same institution. In 1879 he began his long career in railway engineering. For the next quarter of a century he was engaged in construction and maintenance work in connection with steam railways, particularly the Northern Pacific. His work on other projects during this period included the following connections: from 1884 to 1885 he was chief engineer in charge of construction of the St. Andrews Bay and Chipley Railroad in Florida; from 1885 to 1887, resident engineer of the Chicago, Burlington, and Northern Railroad, in charge of the construction of terminals in St. Paul and Minneapolis; and in 1887, chief engineer in charge of the location and construction of the Duluth, Watertown, and Pacific Railroad.

From 1901 to 1903 Mr. Darling was chief engineer of the Northern Pacific Railway, reporting to the president on construction and surveys and to the general manager on maintenance. For the next two years he served the Rock Island System in a similar capacity, and, during the same period, was vice-president of the Gulf Construction Company. From 1906 to 1916 he was chief engineer of the Northern Pacific Railway and allied lines, as well as vice-president and engineer of what is now the Spokane, Portland, and Seattle Railway. During this period of his connection with the Northern Pacific, several hundred miles of new double-track lines were built to eliminate grade and curvature; terminals were revised and enlarged; 750 miles of branch line were constructed; and numerous viaducts, bridges, and tunnels were built.

His war record includes membership on the Minnesota Board for Industrial Preparedness and associate membership on the U. S. Naval Consulting Board. In 1917 he was a member of the U. S. commission of railway experts sent to Russia, where reports were made on the 5,500 miles of Trans-Siberian line from Petrograd south to the Caspian and Black seas. Upon his return to the United States in January 1918, he was active in national and state war work.

Since 1921 he has served in various important organizations including the Board of Economics and Engineering of the National Association of the Owners of Railway Securities. He has been chairman of a committee of engineers representing various societies of the Twin Cities, appointed to recommend the best procedure for disposing of sewage in the metropolitan area. He has also acted as chairman of an engineering committee for determining the physical value of the St. Paul City Railway. As evidence of the high regard in which his fellow citizens hold him both personally and professionally, a number of his civic and technical activities may be mentioned. Among them are his duties as a member of the St. Paul City Planning Board and of the St. Paul Zoning Board, and as engineering consultant to the building committees of the Children's Hospital, St. Luke's Hospital, the St. Paul Day Nursery, and the Summit School. These diverse activities bear adequate testimony to his versatility and integrity.

With all these interests he has never forgotten his first love—railroading, especially the economic problems of railroad location, construction, and operation. His work as chief engineer of the Northern Pacific Railway is a monument to his efficiency and an inspiring example for young engineers to emulate. Duties and honors in other fields have never succeeded in deflecting his keen interest in the major developments of the railway world. In particular, he has been active in analysis and discussion of the numerous plans that have been advanced for the improvement of the general railway situation.

In addition to his acquaintances in church and fraternal affiliations, Mr. Darling has a host of friends. His several hobbies engage a good deal of his attention: he likes to follow the trend of corporate securities, and he is interested in baseball and football. His remarkable physical condition may be due to the fact that he does a little walking every day, but in that respect he is a notable exception to the present trend of the times as he does not believe in allowing a golf ball to spoil a good walk.

In 1892 he was elected a Member of the Society, serving as Director from 1917 to 1919. He is also a member of the American Railway Engineering Association and an honorary member of the Northwest Chapter of the Associated General Contractors of America and of the Association of Engineers of Leningrad (Russia). Election to honorary membership in the Society comes to Mr. Darling as a fitting tribute from his fellow engineers to commemorate a worth-while and successful lifetime of engineering accomplishment.

MILO S. KETCHUM

IT is deeply to be deplored that Dean Milo S. Ketchum should have died on December 19, 1934, during the interim between the time of his election to honorary membership, in September 1934, and the ceremony of award, in January 1935. Far and wide, he was recognized as being in the vanguard of leaders in engineering education. Not only had he developed many outstanding engineers and teachers, but his views on their training were unusually sound and progressive. The following brief résumé of his accomplishments, originally expected to partake of the character of a joyous congratulation, becomes instead a sincere tribute to his memory.

Born at Burns, Ill., on January 26, 1872, Milo S. Ketchum was graduated from the University of Illinois with the degree of bachelor of science in civil engineering in 1895, and received the degree of civil engineer in 1900. In the fall of 1895 he began his career of teaching at the University of Illinois. This career has carried him through all degrees and honors, culminating in 1923 in the rank of Dean of the College of Engineering and Director of the Engineering Experiment Station. He was retired from this position in 1934 and was made Dean of the College of Engineering and Director of the Engineering Experiment Station Emeritus. Twice during his career, Dean Ketchum was called away from Illinois to teach at other universities. In 1904 he went to the University of Colorado where, from 1905 to 1919, he held the position of Dean of the College of Engineering. From 1919 to 1923 he was Director of the Department of Civil Engineering at the University of Pennsylvania.

In spite of the exigencies of his professorial activities, Dean Ketchum has found time for a variety of practical engineering work, only a few aspects of which can be mentioned here. From 1897 to 1899 he was bridge and structural engineer for the Gillette-Herzog Manufacturing Company, and from 1903 to 1904, contracting manager for the American Bridge Company at Kansas City. During 1909 and 1910, while on a leave of absence from the University of Colorado, he was associated with Herbert S. Crocker, Past-President of the Society, under the firm name of Crocker and Ketchum, consulting engineers, in Denver, Colo. In 1918–1919 he again left the University of Colorado to become assistant director of the U. S. Government Explosive Plants, being in charge of construction of the smokeless powder plant at Nitro, W.Va.

The list of books to his credit is a long one. All were pioneers in

their respective fields and show a fine balance between practice and theory which could be maintained only by a man with his wide experience.

Dean Ketchum's forceful character, inflexible integrity, indefatigable spirit, great leadership, and intense loyalty have been an inspiration to his associates. Due to his activity as a member and his regular attendance at the meetings of the technical and professional societies allied with his field of engineering, through his books and other publications, and his lifelong devotion to engineering education, he was widely known as an able practicing engineer and a leader in engineering education.

His views on engineering education were sound and progressive. Among other things he believed that engineering students should be given thorough, basic training in the fundamentals and definite instructions, and that they should be taught to analyze their problems, thinking straight through to a logical conclusion, thereby developing that sixth sense of judgment which is so essential to the successful engineer.

Tireless worker as he was, Dean Ketchum's productiveness would have been greatly restricted if he had not had the ability to visualize and plan his work and surround himself with capable co-workers. An outstanding characteristic was his loyalty to subordinates who made good. If what he considered proper recognition in rank and salary could not be obtained for them, Dean Ketchum endeavored (usually successfully) to obtain the recognition elsewhere. He was generous in giving credit. This explains why he was outstanding in his ability to get and keep loyal associates.

He had unusual aptitude and rare judgment in analyzing a situation. His ability to cut through non-essentials and get to basic facts permitted him quickly to render a fair and logical decision. When he knew himself to be in the right and when logic failed, Dean Ketchum was not unwilling to dominate a situation by sheer personality. He was a friendly and human individual. Essentially a serious-minded man, his quick wit and ready humor relieved many a situation.

In 1901 Dean Ketchum became an Associate Member of the Society, and in 1908 a Member. He served as Director from 1918 to 1920 and as Vice-President from 1925 to 1926. His membership in other societies included the Society for Promotion of Engineering Education (president, 1917–1918), the American Society for Testing Materials, the American Railway Engineering Association, the American Concrete Institute, and the Western Society of Engineers. He was a member of Sigma Xi, Sigma Tau, Tau Beta Pi, and an honorary member of Chi Epsilon. In 1926 the Colorado School of Mines conferred the honorary degree of doctor of science upon him, and in 1927 the University of Colorado gave him similar recognition.

Too much cannot be said of the qualities of mind and character possessed in a high degree by Dean Ketchum. In conferring honorary membership on him posthumously, the Society is recognizing the merits and achievements of an outstanding engineer who served the Society well and devoted his life to the advancement of the profession.

ROBERT RIDGWAY

ROBERT RIDGWAY holds a unique place in the regard and affection of American engineers. Ask almost anyone connected with construction work. Either he knows of Mr. Ridgway or, more likely, counts him a personal friend. What is more, the odds are entirely in favor of the probability that Mr. Ridgway also recollects the man by name and by intimate acquaintance. It has become a commonplace that perhaps no engineer in America, or at least no member of the Society, has as extensive or as broad an acquaintance as Robert Ridgway.

His advancement and honors have been entirely self won. He belongs to that eminent group, now small and rapidly growing smaller, who gained their spurs in the field of practice rather than in the classroom. Having laid a foundation for his life work by studies in the public schools and at his Brooklyn, N.Y., home, he embarked at the age of 19 on his long engineering career and for two years was engaged in railroad work in the Northwest. Returning East in 1884, he entered the employ of the City of New York for what was to prove an uninterrupted service for the remainder of his professional life.

What is perhaps even more unique, this service, entirely connected with construction, involved only two city departments—water supply and subways. Ordinarily engineers persist in working themselves out of their jobs. In Mr. Ridgway's case his work won him promotions in his jobs, even to the very top. His connection with the New York Water Supply was in two periods, 1884–1900 and 1905–1912, relating respectively to the Croton and the Catskill sources. During the construction of the Catskill aqueduct he was in charge as department engineer of the northern 60 miles of the project, including the famous Hudson River crossing, which even by itself is recognized as an engineering epic.

As this work neared completion, the city naturally sought to retain one who had done such notable work on a difficult project. Thus Mr. Ridgway was induced to return to the city's subway work to which as division engineer he had made distinctive contribution from 1900 to 1905, during the interim between his periods of aqueduct service. He became engineer of subway construction at a time when this mammoth project was enlarging. His experience stood him in good stead, with the result that the $300,000,000 of contracts were completed with eminent success.

In 1921 he was appointed chief engineer, which position he retained until he reached the limiting age in 1932, when he became consulting engineer with continuing duties. Nor were his services solely confined to the metropolis. He has been called on to advise on many major projects here and abroad. Some of the more important of these include Boulder Dam, the Chicago subways, and the Trans-Bay Bridge in San Francisco.

Honors have come to him by the score. In the Society he has been successively Director, Vice-President, and President. Fam-

ROBERT RIDGWAY

WILLIAM L. DARLING

THE LATE MILO S. KETCHUM

ous colleges, recognizing his merit and achievement, have corrected an accident of early fate by bestowing on him in his mature years deserved degrees. Harvard, New York University, Lehigh University, and Brooklyn Polytechnic Institute have thus honored him, the latter two bestowing doctorates. Japan also has distinguished him with one of its highest foreign awards, the Order of the Rising Sun, Third Class.

Engineers far and wide have already granted to Mr. Ridgway an esteem that is beyond formal recognition. Within the Society this is especially true, and yet he has not been willing to sit idly by as the mere recipient of merited honor. Even when his time came to be increasingly in demand, he more than fulfilled his duties as a good member. Attendance at meetings, membership on important committees, visits to Local Sections and Student Chapters, and contributions to meeting programs and to Society publications have regularly constituted his share in Society activities.

Honorary membership is accorded primarily for acknowledged eminence in some branch of engineering, although that is by no means the sole criterion. In the case of Robert Ridgway there is universal accord that the honor is conferred upon him for the possession of exceptional personal as well as professional characteristics. The highest degree of integrity has motivated his actions and thoughts in both business and personal relationships. He is punctilious in his obligations to others; no effort is too great for him to make where a kind thought or a generous act may help another. Perhaps, after all, it is this sympathy for others that constitutes that personal charm which has endeared him so to those who have been privileged to know him. By any standard of measurement Robert Ridgway deserves this, the highest evidence of professional and personal esteem. His fellow engineers with especial delight acclaim him an Honorary Member.

Gathering of Metropolitan Student Chapters

AT THE FALL conference of Metropolitan New York City Student Chapters, held on December 5, the Chapter at the Newark College of Engineering was host to more than 200 students from eight Chapters. The speaker of the evening, Robert Ridgway, Honorary Member and Past-President of the Society, used many lantern slides in illustrating his talk on the construction of New York subways and the Catskill Aqueduct. He also told the students that he envied them their opportunity to participate in the solution of the engineering problems which must be solved within the next ten or fifteen years.

The meeting was conducted entirely by the student officers after President Allan R. Cullimore, of the Newark College of Engineering, had welcomed the conference and called attention to the very considerable amount of thought and time which is given to the problems of young engineers by older members of the profession. The meeting was then turned over to Thomas B. Quilty, chairman of the Metropolitan Conference.

In the spring of 1933 the Conference of Metropolitan Student Chapters was formed by representatives of the seven Chapters within rapid transit distance of each other, namely, those at Columbia University, the College of the City of New York, Cooper Union, Manhattan College, New York University, Newark College of Engineering, and the Polytechnic Institute of Brooklyn. Its purpose is "to foster desirable relations among the various Student Chapters and to further the knowledge of the standards and ethics of the engineering profession." Two members from each Chapter constitute an executive committee. Each Chapter in turn is host to the conference and holds one fall meeting with an invited speaker and one spring meeting at which are presented four student papers for which prizes are given.

It is interesting to note that the Philadelphia Section has for several years sponsored annual regional student conferences, and that two or three other districts are considering the formation of similar units in the immediate future. The Society's Committee on Student Chapters is giving this movement full encouragement.

Palmer C. Ricketts Passes Away

NEWS of the death on December 10 of Palmer C. Ricketts, Hon. M. Am. Soc. C.E., came as a great shock to his host of friends and former students. For 59 years Dr. Ricketts was a member of the faculty of Rensselaer Polytechnic Institute of Troy, N.Y., and for the past 33 years he was its president. Certainly this long and distinguished career as an educator in the field of technical and professional training can be equaled by few. He was born at Elkton, Md., on January 17, 1856, graduated from Rensselaer Polytechnic Institute in 1875 with the degree of C.E., and began his work there as an instructor the same year, a connection which continued until his death.

The influence of his work as an educator is indicated in an editorial which appeared in *The New York Times* of December 12, 1934. In it President Ricketts is designated as the "rebuilder" of the oldest school of science and engineering in any English speaking country. He "not only built the new Rensselaer after the fire of 1904, giving it a great group of buildings and a spacious campus, he liberalized the scope of its curriculum without imperiling its technical and professional training.... What he did at Rensselaer has influenced other schools.... In the death of President Ricketts they (engineers) have lost a great and fearless leader."

While Palmer Ricketts devoted an entire life to Rensselaer, he found time to design and direct engineering works in his city and state for public improvements and for river development. His advice was sought in patent cases. He was a director of both the National City Bank and the Samaritan Hospital; and a trustee of the Troy Public Library and the Dudley Observatory (Albany, N.Y.).

PALMER CHAMBERLAINE RICKETTS, 1856–1934
Hon. M. Am. Soc. C.E.

Technical societies also claimed and received his attention. He held membership in the American Society of Mechanical Engineers, the American Institute of Mining Engineers; and the Institute of Civil Engineers of Great Britain. The first of these societies elected him an honorary member in 1931. His membership in the American Society of Civil Engineers dates back nearly half a century—to 1886. From 1899 to 1901 he was a Director of the Society; in 1916 he was elected one of its Vice-Presidents and in 1931 he received from it the highest honor within its power to give, that of Honorary Membership. Indeed in the passing of Palmer C. Ricketts the Society has lost a faithful friend and the profession a distinguished and successful educator, who has worked tirelessly for its advancement for nearly three-score years.

In 1895 he wrote a *History of Rensselaer Polytechnic Institute*. He has been a contributor to technical literature.

Funeral services were held in Troy, in the auditorium of Ames Eaton Hall, Rensselaer Polytechnic Institute. The Society was represented by George S. Davison, Past-President, and by Phillip W. Henry, Daniel L. Turner, and J. A. L. Waddell, Members Am. Soc. C.E.

Liabilities of Engineers Under the Securities Act of 1933

As Amended by Title II of the Securities Exchange Act of 1934

By W. W. COLPITTS, M. AM. SOC. C.E.

COVERDALE AND COLPITTS, CONSULTING ENGINEERS, NEW YORK, N.Y.

UNDER present laws grave responsibility rests on the engineer in reporting on projects against which securities are to be issued. At the request of the Society, Mr. Colpitts has made a study of this situation, which vitally affects so many members. His abstract of the Securities Act and his comments will be found valuable and practical. Reprints of this article in pamphlet form will be available at nominal cost.

THIS STATEMENT is not intended to be in any sense a legal interpretation of the Securities Act, either in whole or in part. It undertakes only to outline in non-legal terms a layman's views with respect to the obligations, liabilities, and limitations imposed upon the engineer by the Act. It seemed advisable that this statement should take the form it does, beginning with a digest of the Act, for the reason that the implications of this new law are so far-reaching in their bearing upon the work of every engineer whose practice brings him within its scope as to make it necessary that he read the Act itself, or at least a digest such as is here presented.

In this digest, those provisions which particularly concern the engineer are given in full. The abbreviated sections are necessarily incomplete and are subject to the limitations of a layman's interpretation, but they are thought to be outlined in sufficient detail to indicate their nature in general terms and to show their relationship to those sections in which the engineer is especially interested. For a complete understanding of the abbreviated provisions the reader is referred to the Act itself.

Digest of Securities Act of 1933 as Affecting Engineers

Section 1. Short Title. This title may be cited as the "Securities Act of 1933."

Section 2. Definitions. Defines all terms used in context.

Section 3. Exempted Securities.

(*a*) Except as hereinafter provided, provisions of this title shall not apply to the following:

(1) Any security sold prior to or within 60 days of enactment of this title;

(2) Any securities issued by the United States or any State or Territory or District of Columbia or by any instrumentality thereof;

(3) Any note, etc., arising out of a current transaction;

(4) Any security issued for charitable or similar non-profit purpose;

(5) Any security issued by building and loan associations, etc., unless issuer takes over 3 per cent as fee;

(6) Any security issued by a common carrier subject to Section 20*a* of Interstate Commerce Act;

(7) Certificates issued by a receiver or trustee in bankruptcy, with approval of court;

(8) Any insurance or endowment policy;

(9) Any security exchanged by issuer with its existing security holders where no commission is paid;

(10) Any security exchanged for outstanding securities, claims or property, or partly such in exchange and partly for cash where approved by court;

(11) Any security which is part of an issue sold only to persons resident within a single State where issuer is a resident and doing business within such State.

(*b*) Commission may add any class of securities to exempted list, but none shall be exempted under this subsection where amount exceeds $100,000.

Section 4. Exempted Transactions. The provisions of Section 5 shall not apply to any of the following transactions:

(1) Transactions by any person other than issuer, underwriter, or dealer; transactions by an issuer not involving any public offering, etc.

(2) Brokers' transactions.

Section 5. Prohibitions Relating to Interstate Commerce and the Mails.

(*a*) Unless a registration statement is in effect as to a security, it shall be unlawful:

(1) to use instruments of transportation or communication in interstate commerce or the mails to sell such security; or

(2) to carry such security through mails, or in interstate commerce by instruments of transportation.

(*b*) It shall be unlawful:

(1) to use instruments of transportation in interstate commerce or the mails to transmit prospectus unless requirements of Section 10 are met;

(2) to carry through the mails or in interstate commerce such security unless accompanied or preceded by prospectus that meets requirements of Section 10.

Section 6. Registration of Securities and Signing of Registration Statement.

(*a*) Security may be registered with Commission by filing registration statement in triplicate, at least one to be signed by each issuer, its principal executive, financial, and accounting officer, and majority of board, and if issuer is a foreigner, by representative in Unites States; except where issued by foreign government, it may be signed only by underwriter. Burden of proof shall be on person denying signature.

(*b*) Filing fee $^1/_{100}$ of one per cent of offering price, but not less than $25.

(*c*) Registration statement deemed filed on its receipt accompanied by fee.

(*d*) Registration statement available to public at reasonable charge.

Section 7. Information Required in Registered Statement. Registration statement (unless of foreign government) shall contain information specified in Schedule A, and for foreign government as specified in Schedule B; except that Commission may determine that such information is inapplicable and require other. (Schedules A and B omitted in this abstract.)

> "If any accountant, engineer, or appraiser, or any person whose profession gives authority to a statement made by him, is named as having prepared or certified any part of the registration statement, or is named as having prepared or certified a report or valuation for use in connection with the registration statement, the written consent of such person shall be filed with the registration statement."

If any person named as having prepared or certified a report or valuation (other than a public official document) which is used in connection with the registration statement, but is not named as having prepared or certified it for such use, the written consent of such person shall be filed with the registration statement, unless Commission dispenses with such filing as an undue hardship.

Commission may add to information required.

Section 8. Taking Effect of Registration Statements and Amendments Thereto.

(*a*) Effective date 20th day after filing, except as hereinafter provided, and except in case of securities of foreign public authority which has fully met service of its obligations in United States, the proceeds of which are to refund obligations payable in United States, registration statement shall become effective 7 days after filing. Any amendment filed prior to effective date extends filing date of registration statement, with certain exceptions.

(*b*) If Commission considers registration statement is on its face incomplete or inaccurate in any material respect it may refuse to allow it to become effective until amended.

(*c*) An amendment filed after effective date of registration statement and found not incomplete shall be effective on date fixed by Commission.

(*d*) "If it appears to the Commission at any time that the registration statement includes any untrue statement of a material fact or omits to state any material fact required to be stated therein or necessary to make the statements therein not misleading," the Commission may suspend its effectiveness. When properly amended Commission shall remove suspension.

(*e*) Commission may make an examination in any case to determine (*d*). Commission may investigate thoroughly and examine parties under oath.

(*f*) How notices required under this section shall be served.

Section 9. Court Review of Orders.

(*a*) Provides method for court review of orders of Commission.

Section 10. Information Required in Prospectus.

(*a*) A prospectus,

(1) When relating to other than a foreign government security shall contain the same statements made in registration statement, excepting documents as in (28) to (32) of Schedule A;

(2) similarly for foreign government securities, excepting documents as in (13) and (14) of Schedule B.

(*b*) Notwithstanding (*a*),

(1) when prospectus used more than 13 months after effective date of registration statement the information shall be as of not more than 12 months prior to such use.

(2) Commission may permit prospectus to omit part of information under (*a*).

(3) Commission may require that prospectus contain additional information.

(4) Commission may classify prospectuses and specify form and contents.

(*c*) Statements required in a prospectus under (*a*) or (*b*) shall be as conspicuous and in as large type as in body of prospectus.

(*d*) Copies of radio broadcast prospectuses shall be filed with Commission.

Section 11. Civil Liabilities on Account of False Registration Statement.

(*a*) "In case any part of the registration statement, when such part became effective, contained an untrue statement of a material fact or omitted to state a material fact required to be stated therein or necessary to make the statements therein not misleading, any person acquiring such security (unless it is proved that at the time of such acquisition he knew of such untruth or omission) may. . . . sue:

"(1) every person who signed the registration statement;

"(2) every person who was a director of, ... or partner in, the issuer at the time of the filing of the part of the registration statement with respect to which his liability is asserted;

"(3) every person who, with his consent, is named in registration statement as being or about to become a director, ... or partner;

"(4) every accountant, engineer, or appraiser, or any person whose profession gives authority to a statement made by him, who has with his consent been named as having prepared or certified any part of the registration statement, or as having prepared or certified any report or valuation which is used in connection with the registration statement, with respect to the statement in such registration statement, report, or valuation, which purports to have been prepared or certified by him;

"(5) every underwriter with respect to such security. If such person acquired the security after the issuer has made generally available to its security holders an earning statement covering a period of at least 12 months beginning after the effective date of the registration statement, then the right of recovery under this subsection shall be conditioned on proof that such person acquired the securities relying on such untrue statement in the registration statement or relying on the registration statement and not knowing of such omission, but such reliance may be established without proof of the reading of the registration statement by such person."

(*b*) Notwithstanding (*a*), no person, other than the issuer, shall be liable as provided therein who shall sustain the burden of proof,

(1) that before effective date of part of registration statement with respect to which his liability is asserted (*A*) he had resigned or refused to act in capacity in which he was described in registration statement as acting; and (*B*) he had advised Commission and issuer of such action and would not be responsible; or

(2) that if such part of registration statement became effective without his knowledge, upon becoming aware of which he advised Commission as in (1) and gave public notice; or

(3) that (*A*) as regards any part of the registration statement

not purporting to be made on the authority of an expert, and

not purporting to be a copy from a report or valuation of an expert, and

not purporting to be made on authority of a public official document,

he had, after reasonable investigation, reasonable ground to believe and did believe, at time such part of registration statement became effective, that statements therein were true and that there was no omission of a material fact; and

(*B*) as regards any part of the registration statement,

purporting to be made upon his authority as an expert or

purporting to be a copy from a report or valuation of himself as an expert,

(i) he had, after reasonable investigation (etc.), or

(ii) such part of the registration statement did not fairly represent his statement as an expert or was not a fair copy from his report or valuation as an expert; and

(*C*) as regards any part of the registration statement,

purporting to be made on the authority of an expert (other than himself) or

purporting to be a copy from a report or valuation of an expert (other than himself)

he had no reasonable ground to believe (etc.), or that such part of registration statement did not fairly represent the statement of the expert or was not a fair copy from the report or valuation of the expert; and

(*D*) as regards any part of the registration statement,

purporting to be a statement by an official person, or

purporting to be a copy of a public official document,

he had no reasonable ground to believe, etc.

(*c*) "the standard of reasonableness shall be that required of a prudent man in the management of his own property."

(*d*) If any person becomes an underwriter of the security after the part of the registration statement to which his liability is asserted has become effective, then as to (3) of (*b*) such part of the registration statement shall be effective to such person when he became an underwriter.

(*e*) The suit authorized under (*a*) may be to recover damages in stated forms:

Provided, that if defendent proves that any portion or all of such damages represents other than the depreciation in value of such security resulting from such part of registration statement, with respect to which his liability is asserted, being untrue or omitting to state a material fact, such portion of or all of such damages shall not be recoverable. In no event shall any underwriter (unless he received benefits not accorded to others) be liable in any suit or as a consequence of suits under (*a*) for damages in excess of price offered to public. In any suit under this or any other section of this title, the court may require an undertaking for the payment of the costs of any suit, including reasonable attorneys' fees, and if judgment is rendered against a party to the suit assess such costs on such party if the court believes the suit or the defense to have been without merit.

(*f*) All or any one or more of the persons specified in (*a*) shall be jointly and severally liable. Provision for recovery.

(*g*) In no case shall the amount recoverable under this section exceed the price at which the security was offered to the public.

Section 12. Civil Liabilities Arising in Connection with Prospectuses and Communications. Any person who:

(1) sells a security in violation of Section 5, or

(2) sells a security (whether or not exempted by Section 3, other than (2) of (*a*) thereof), by use of instruments of transportation or communication in interstate commerce or the mails, by prospectus or orally, which includes an untrue statement or omission of a material fact (the purchaser not knowing of such untruth or omission), and who shall not sustain the burden of proof that he did not know, and in the exercise of reasonable care could not have known, of such untruth or omission,

shall be liable to the person purchasing such security from him, who may sue to recover the consideration paid with interest, less the income received, upon the tender of such security, or for damages if he no longer owns the security.

Section 13. Limitations of Actions. No action shall be maintained to enforce any liability created under Section 11 or Section 12 (2) unless brought within one year after the discovery of the untruth or omission, or after such discovery should have been made by reasonable diligence, or, if action is to enforce liability under Section 12 (1), unless brought within one year after the violation upon which it is based. In no event shall such action be brought to enforce a liability created under Section 11 or Section 12 (1) more than three years after security was bona fide offered to public, or under Section 12 (2) more than three years after the sale.

Section 14. Contrary Stipulations Void. Any stipulation binding any person to waive compliance with any provision of this title shall be void.

Section 15. Liability of Controlling Persons. Every person who, through stock ownership or otherwise, or who, pursuant to an agreement, controls any person liable under Section 11 or 12, shall also be liable jointly and severally with and to the same extent as the controlled person, unless the controlling person had no knowledge of the facts making the controlled person liable.

Section 16. Additional Remedies. The rights and remedies provided by this title shall be in addition to all others at law or in equity.

Section 17. Fraudulent Interstate Transactions.

(*a*) It shall be unlawful for any person in sale of securities by use of any means or instruments of transportation or communication in interstate commerce or the mails

(1) to employ any means to defraud;

(2) to obtain money or property by untrue statement or material omissions; or

(3) to engage in any transaction which would operate as a fraud.

(*b*) It shall be unlawful for any person, by use of any means or instruments of transportation or communication in interstate commerce or the mails, to publish or circulate any notice which, though not purporting to offer a security for sale, describes such security for a consideration from an issuer, underwriter or dealer, without fully disclosing the consideration.

(*c*) The exemptions in Section 3 shall not apply to this section.

Section 18. State Control of Securities. Nothing in this title shall affect the jurisdiction of the securities commission, or similar body, of any State or Territory.

Section 19. Special Powers of Commission.

(*a*) The Commission may make, amend, and rescind rules and define terms; may prescribe forms for supplying information and nature of information.

(*b*) In any investigation any commissioner or designated officer may administer oath, issue subpoenas, etc.

Section 20. Injunctions and Prosecutions of Offenses.

(*a*) Whenever the Commission is advised that provisions of this title have been or are about to be violated, it may require complainant to state complaints in writing, under oath, and investigate.

(*b*) Whenever Commission believes any person has violated or is about to violate provisions of this title, it may bring an action to enjoin and institute criminal proceedings.

(*c*) Upon application of Commission, certain courts may issue writs of mandamus commanding any person to comply with provisions of this title.

Section 21. Hearings by Commission. All hearings shall be public and records shall be kept.

Section 22. Jurisdiction of Offenses and Suits.

(*a*) District courts of United States, United States courts of any Territory, and Supreme Court of District of Columbia.

(*b*) Provides for contumacy or refusal to obey.

(*c*) Provision in respect of self-incriminating evidence.

Section 23. Unlawful Representations. The fact that the registration statement has been filed, or is in effect, shall not be deemed a finding by the Commission that the registration statement is true and accurate on its face, or that the Commission has approved the security.

Section 24. Penalties. Any willful violator of provisions of this title, or any person who, in a registration statement filed under this title, willfully makes an untrue statement or omits a material fact, shall be subject to a fine of not more than $5,000 or imprisonment for not more than five years, or both.

Section 25. Jurisdiction of Other Government Agencies over Securities. Nothing in this title shall relieve any person from submitting information, reports, etc., to other supervisory units of the Government.

Section 26. Separability of Provisions. If any provision of this act, or its application, shall be held invalid, the remainder of the Act shall not be affected thereby.

Comment on Act as Applied to Engineers

Attitude of Engineers Toward the Act

It has been stated by the men who framed the Securities Act of 1933, as well as by those who sponsored its passage through Congress, that no man need be apprehensive as to his responsibilities under the Act, provided his work has been done honestly, faithfully, and intelligently.

Before proceeding to suggest the course it would seem advisable an engineer should pursue to avoid violation of any of the provisions of the Act, which is the subject of this discussion, two brief statements should be made which it is believed indicate the present attitude of the engineer toward the Act: first, that in the whole history of the issuance of corporate securities in this country, which have depended in any degree upon the reports of responsible engineers, the charge of dishonesty, faithlessness, or incompetence could be sustained in so few instances as in no way to reflect discredit upon the profession as a whole, or to require the drastic provisions of the Securities Act to prevent the recurrence of these shortcomings; and, second, that the conditions which lead to the passage of the Act were, in large measure, the result of the issuance and sale to the public or securities for important projects and purposes upon which no reports whatever had been made by responsible engineers, and this notwithstanding the fact that as far back as September 1923 strong representations were made by prominent members of the profession to important houses of issue that such examinations were a necessary protection to investors, as well as to bankers. A further, and perhaps unnecessary observation, is that in many other cases the issues failed because of conditions entirely beyond the engineer's knowledge or control, or the range of his work.

Necessity for Fixing Liability of Engineers

It should be borne in mind that in the drafting of the Securities Act no effective safeguards could be placed around the issuance of securities without embracing the part played by engineers, as well as by bankers and accountants, and the officers and directors of the issuing corporations. It is true that all responsible engineers are bound by strict rules of professional ethics. It is also a fact that the Code of Ethics of the Society (which must be adhered to as a condition of membership) exerts a greater measure of ethical control upon the members of the Society than do the provisions of the Securities Act in so far as they apply to engineers. The important distinction is that the Securities Act provides very severe penalties for dereliction of duty.

Every engineer, therefore, who in the future may undertake to determine any portion of the facts upon which an issue of securities is to be based, should realize fully the responsibilities he assumes under the Securities Act and the nature of the penalties to which he subjects himself for inaccurate, incomplete, or unwarranted statements.

Registration Statement

The Act provides for the filing with the Federal Trade Commission of a registration statement in connection with the issuance of any new securities (in excess of $100,000) to be sold in interstate commerce. Under the law and the regulations of the Commission, the registration statement must be very complete with respect to all of the pertinent features of the issuer's business; and in many instances, particularly those in which large sums of money are involved, this calls for a vast amount of detailed information, including statements by accountants, reports by engineers and/or other experts. As will be seen from a study of the foregoing abstract, it is in the preparation of such reports or the furnishing of information of any kind upon which the security of the issue depends in any degree that the engineer, in consenting to its use in connection with the registration statement, becomes subject to the provisions of the Act.

The participants in the filing of a registration certificate are jointly and severally liable for all the statements made in so far as each has participated.

Line Between Work of Accountants and Engineers

In an examination upon which an issue of securities is to be based, the line of demarcation between the work which should be done by the engineer and that which should be done by the accountant is often somewhat vague. The accountant finds less difficulty in fixing the limits of his own work, but the range of the engineer's work may go well beyond this ill-defined line to include an analysis of balance sheet items and a review of past earnings, as well as an estimate of the prospects for the future. If, on the subject of balance sheet items and past earnings, the engineer presumes to speak with authority, it may be assumed that he becomes subject to all the liabilities attaching to an accountant. It would seem, therefore, that his only safe course is to begin where the accountants leave off, accepting the accountant's statements at face value and without responsibility for their truth, completeness, or accuracy; unless, because of his presumed greater familiarity with a particular subject, such for instance as depreciation of physical plant or physical valuation, he feels justified in expressing a view different from that of the accountant. In any such case, he should state clearly the reasons for his dissenting opinions and define accurately the limitations of his own findings.

Liability for Untrue Statements or Omission of Material Facts

The engineer's report must not contain an untrue statement of a material fact, or omit to state a material fact necessary to make the statements therein not misleading. For any such untrue statement or omission he is liable in damages to any purchaser of the security, unless he can prove that, after reasonable investigation he had reasonable ground to believe and did believe that the statements were true and that there were no omissions. Should the engineer, as a defendant in a suit, be able to prove that any portion of the damages represents other than the loss in value of the security resulting from the untrue statement or omission, such portion shall not be recoverable. It is not necessary, however, for the purchaser to prove that he ever read or even saw the registration statement, the prospectus, or the report, or relied on the untrue statement or omission; except that a person who acquires a security after the issuer has published an earnings statement for a full 12-months' period beginning after the effective date of the registration statement, cannot recover unless he relied on the untrue statement or on the registration statement, which reliance may be established without proof of the reading of the registration statement. A purchaser must sue either one year after he learns, or should have learned, of the untrue statement or omission, and within three years after the security was bona fide offered to the public.

It is highly important that the engineer understand the full import of this provision. Under it he assumes a liability to defend himself throughout this three-year period in any suit that may be brought in which his work is involved. Further than this the burden of proof is placed on him to show that he performed his full duty as required by the Act. As unusual as it may seem, this latter provision is apparently at variance with the English common law doctrine that a man is assumed to be innocent until he is proved guilty. The fear that it may lead to unjustified litigation would not seem to be ill-founded.

The purchaser of the security has no cause of action if he knew of the mistake when he bought the security. That this was the case may, however, be difficult to prove.

In the matter of omissions, in any case in which the engineer has consented to the filing of his report, he is on equally dangerous ground because of the breadth of the field and the difficulty of determining the sort of omission that may result in liability. What may seem to the engineer to be an irrelevant or unimportant omission may a year later appear to a court or jury to be pertinent to a correct valuation of the security.

Fact Versus Opinion

While liability apparently exists only for untrue statements or omission of material facts, the implications of the Act are such that the engineer must distinguish clearly in his reports between fact and opinion. He must fix the line of cleavage so accurately

as not to permit of a viewpoint different from his own on such a question.

An estimate of prospective earnings, which is frequently the crux of an engineer's report, is in fact a statement of opinion. It is usually based on a record of past earnings from which non-recurring and other inapplicable items have been eliminated, and thus, for the purpose for which it is to be used, this record, as adjusted, becomes a matter of fact. But, in translating the facts of past earnings into opinions of future prospects, after giving effect to the expenditure of new money for improving the plant and equipment, to greater efficiency through changes in personnel, and generally to expected increase in output and reduction in expenses, there is always danger that the prospective purchaser of the security may fail to recognize the point where fact ends and opinion begins. It is the part of prudence, therefore, for the engineer to outline clearly the whole basis for his estimates, the manner in which they have been prepared, and the sources of all facts used in forming his opinions. If he is conscious of any doubts or misgivings in his own mind as to the reliability of his sources of information or the validity of his findings, he should state them. It is essential that he be conservative in his statements, but not at the expense of accuracy.

In the matter of appraisals also the engineer should observe extreme caution. It may be necessary to distinguish between the value of the appraised items in a going concern and their value if the business is about to be wound up. Depreciation and obsolescence are important items which must not be under- or overstated. The uncertain question of the value of inventory that has become partially or wholly obsolete should have the most painstaking consideration. In all items, but especially in the case of machinery, tools, and equipment, the nature and sources of his information as to condition and value should be stated in his report, or held available for his own protection and that of his client in the event of a suit. It cannot be too strongly emphasized that his records should be complete in every detail.

Reliance Upon Others

As stated above, if the engineer proves that he made a reasonable investigation and had reasonable ground to believe and did believe, at the time the registration statement became effective, that his report contained no untrue statements and that no material facts were omitted, he is relieved of liability. "The standard of reasonableness shall be that required of a prudent man in the management of his own property."

The indefiniteness, which is perhaps necessary, of the terms "reasonable investigation" and "reasonable ground to believe" raises the question of the extent the engineer may rely upon statements of officers and employees of the company he is examining, or on the work of his own employees, without personal verification in detail.

Since the burden of proof is on the engineer, it is highly important that he keep a complete record of everything he did in the course of his investigation, the persons he interrogated, and the information gained from them, the records he examined and the part played by each of his own employees. Needless to say his employees should be competent and responsible.

Indemnity Fees

The liabilities the engineer assumes under the Act are so heavy in relation to the ordinary schedule of professional fees as to suggest the advisability o requiring a guaranty of indemnity from the client. Not only does the engineer assume grave initial responsibility but, should the issuer of the securities become bankrupt, the whole burden of defending a suit would, presumably, fall upon the experts and correspondingly enlarge their liability. On the other hand, a guaranty of indemnity would be of no value should the guarantor become insolvent and, in any event, such a guaranty is difficult to obtain. Undoubtedly many houses of issue would decline to sponsor a security rather than assume these obligations in addition to those which the Act directly imposes on them.

The situation is somewhat mitigated by a provision of the Act which gives the court power to require an undertaking for the payment of the costs of any suit, including reasonable attorneys' fees and, if judgment is rendered against a party to the suit, to assess such costs on such party if the court believes the suit or the defense to have been without merit. If the courts make use of this provision it may serve as a deterrent to blackmail suits.

Conclusion

A close study of the Act leads to the conclusion that the engineer is not placed in jeopardy by the Act because of any presumption of habits of exaggeration, looseness of statement, or willful misrepresentation. His tendency has been distinctly in the opposite direction. In the light of the provisions of the Act it can be said, however, that in the future the engineer cannot rely too much upon his reputation as an authority, but must give his clients and the public the full sources of his facts and the complete reasons for his opinions.

Due to his fallibility, and to his inability to determine out of the great mass of data he may collect what should be set forth in his reports and what should be omitted, and perhaps to his own personal equation, the engineer is now subjected to hazards in the practice of his profession to which he is unaccustomed, and he must adjust himself to the new order.

In view of the position which these aspects of the law present it would appear that the fees charged by engineers must be regulated in accordance with the responsibilities they must now assume.

Society's Oldest Member, William H. Burr, Dies

AFTER A LONG and distinguished career in the practice of civil engineering and as an engineering teacher, William Hubert Burr, M. Am. Soc. C.E., died on December 13, 1934. He graduated from Rensselaer Polytechnic Institute in 1872 and began active work in his profession in that year. On June 3, 1874, he was elected a Junior in the Society, thus beginning an affiliation which lasted over sixty years. For a number of years past he has been at the head of the list of members in point of continuous affiliation with the Society.

For eight years, 1876 to 1884, Professor Burr taught mechanics at his alma mater; he spent the college year 1892–1893 as a professor of engineering at Harvard, and in 1893 began his long occupancy of the chair of civil engineering at Columbia University. In 1916, after a total of 36 years of service as a teacher of engineering, he retired from Columbia, but until his death was professor emeritus there.

During his teaching work and since retiring from it, Professor Burr advised many boards and commissions. In 1900 he joined with the late John R. Freeman, Honorary Member and Past-President of the Society, and with the late Rudolph Hering, M. Am. Soc. C.E., in a report to the Board of Water Supply of the City of New York, which constituted the first comprehensive study of the problem of obtaining an additional water supply for the city. The report, which is still considered a classic, formed the basis on which the Catskill Aqueduct system was designed and built. He served also on both President McKinley's and President Roosevelt's Isthmian Canal Commission; and he advised the Port of New York Authority on the George Washington Bridge and the Holland Tunnel. In 1900 he won first place in a national competition for a proposed memorial bridge over the Potomac River at Washington, D.C.

With the death of Professor Burr, another teacher, Robert Fletcher, M. Am. Soc. C.E., Director Emeritus, Thayer School of Civil Engineering, Dartmouth College, becomes the "oldest" member of the Society. His affiliation dates from November 4, 1874.

Membership Applications in Civil Engineering

WITH THIS issue the list of "Applications for Admission or Transfer" appears in CIVIL ENGINEERING for the first time. In the past it has been published in PROCEEDINGS together with a brief abstract of the professional record of the person named. Thus the plan is not new. It is but a change in location, considered to be desirable by the Committee on Publications in its study of the problem of making the use of the list most effective.

The change has several advantages. It leaves PROCEEDINGS almost exclusively a scientific journal free from extraneous matter. It enables the Board of Direction to study the summer lists in monthly instalments, which was not possible during the two sum-

mer months when the publication of PROCEEDINGS is suspended. The change advances the interval for studying applicants and places the abstracted records where they can receive early attention from the members.

A standard position in CIVIL ENGINEERING has been chosen for "Applications for Admission or Transfer"—toward the rear of each issue immediately following "Changes in Membership Grades." As the heading of the new department states, the Constitution of the Society requires the Board of Direction to act on all applications either for admission or for transfer. However, the Board must depend to a large extent on the membership for information on which to base its decisions and to determine justly the eligibility of each candidate. Therefore the list is issued by this means to every member in every grade so that all available information about applicants can be obtained. To uphold the established high standards of membership it is the duty of each member to examine these succeeding lists to insure that no unworthy applicant is accepted because of the absence of pertinent information. The fact that all correspondence concerning applicants is treated in a strictly confidential manner should encourage and not deter members from forwarding promptly to the Board any facts derogatory to the personal character or professional reputation of an applicant.

Every member is encouraged to scan critically each succeeding Preliminary List and to send to the Board any and all data, of which he may be the sole possessor, that may in any way aid in determining the eligibility of an applicant for membership in the Society.

Translation of Lesbros' "Hydraulic Experiments Relative to the Laws of Flowing Water"

THROUGH THE COURTESY of Roswell D. Trimble, M. Am. Soc. C.E., the Society is the recipient of a valuable translation into English of the old French manuscript by Lesbros "Hydraulic Experiments Relative to the Laws of Flowing Water." This copy is a typewritten manuscript of 175 or more pages, representing a tremendous amount of work by Major Trimble. It is dedicated to the Society. The manuscript, which is a gift for filing purposes, will be suitably bound and desposited in the Engineering Societies Library.

The original report, "Experiences hydrauliques sur les Lois de l'Écoulement des Eaux," was made by M. Lesbros, Colonel of Engineers, to the French Ministry of War on experiments relating to the discharge of rectangular orifices and weirs. The experiments were conducted between 1828 and 1834, but Lesbros' report was not completed until some years later. The report is composed of 312 pages of text, more than 50 tables, and an atlas of plates relating to the apparatus used and phenomena pertaining to the movement of liquids. In addition to the results obtained for coefficients of contraction, velocity, and discharge, Lesbros' report is largely devoted to his observations on the jet, phenomena of flow, standing waves, influence of walls and bottom of reservoir, summary of deductions, and a comparison of his results with those presented by earlier experimenters. In his translation, Major Trimble has included the text, tables, and plates relating to Lesbros' 1,665 experiments with orifices, but has omitted the sections of the report that relate to the 353 experiments with weirs. A brief appendix, prepared by the translator, presents explanatory matter pertaining to the text and tables.

In behalf of the Society, the Committee on Publications has expressed its pleasure in the gracious gift made by Major Trimble and its appreciation of the prodigious and painstaking labor which now makes Lesbros' notable work available to the profession in America. The copy now on file in the Engineering Societies Library is one of only three that were made. There it is available for study, or in the case of those not able to visit the library personally, for abstracting or copying by the Library staff, on request.

Discussion in PROCEEDINGS

IN ITS EARLY days when the organization of the profession was a relatively simple matter, the Society as a whole met semimonthly to listen to a paper read by one of its members and to hear technical criticisms of that paper "from the floor." This personal contact between members of the same profession is possible in these days only by dividing the meetings into sessions, under the auspices of the 10 Technical Divisions, through the 57 Local Sections, or through the 109 Student Chapters scattered throughout the United States.

The old order still is in force, nevertheless, in the form of the papers in PROCEEDINGS (later collated and bound as TRANSACTIONS). Each month two or more technical papers of some acknowledged weight are "read" into the record, and in succeeding months the profession appraises these papers "from the floor." The only difference is that now such papers have a potential "audience" of 13,000 members or more, and a "floor" stretching over an area of a round million square miles.

Actually the responsibility of members to submit papers and to take part in the technical discussion of them, has increased rather than diminished. Young or old, professionally eminent or obscure, every member has both the privilege and the duty of expressing his opinion on technical advances in his profession. In order that ample time may be granted every person to prepare a careful appraisal of papers in PROCEEDINGS, the closing date for discussion is established four months from the date of publishing the original paper. When more time than this is needed, a prospective discusser should notify the Society and almost always the closing date can be extended. On certain papers the discussion period has been as long as 12 months or more, but in order that the subject may be concisely treated, it is desirable that the author's closure, which sums up or comments on discussions, be written within a reasonable interval after the presentation of the paper.

Improving Professional Relations

A COMMITTEE of the Metropolitan (New York) Section of the Society has urged the appointment of licensed professional engineers to all administrative and supervisory positions concerned with the engineering work of the Temporary Emergency Relief Administration (TERA) in New York, N.Y. In this connection it has been successful in securing the cooperation of the Director of the Public Works Division of TERA work in New York, who is enforcing such a provision.

However, an anomalous situation exists in the schedule of engineering salaries. Although men in the skilled trade classifications receive a higher hourly or per diem rate, they are limited to $15 per week; whereas professional engineers supposedly receive a minimum of $27 per week. The advantage of a greater weekly wage for engineers apparently must be balanced against the disadvantage of a lower hourly rate. It is a nice question as to whether, under a system which is avowedly on a subsistence wage basis, more per hour should be sought, or whether a larger weekly wage even with longer hours is the better. The traditions of the profession seem to favor the latter.

As the result of the efforts of the same committee, the Mayor of New York has instructed all his department heads to employ no emergency relief workers to replace or displace regular city employees or to do any work belonging to the normal functions of the city government. This is in accordance with principles established by FERA officials at Washington. In the past, emergency relief workers have been used on the engineering design and construction of those municipal improvements that are being carried out with funds from the Federal Government. This procedure has been employed instead of utilizing qualified men already in the preferred Civil Service lists of the city. The practice is by no means confined to New York. Active efforts against the abuses to which Civil Service and its merit system have been subjected should be energetically undertaken throughout the country.

A Metropolitan Regional Committee on Engineers' Employment and Salaries, made up of representatives of 21 interested organizations affiliated at the instance of the Metropolitan Section of the Society, has drafted and presented a recommended classification of engineering positions and salaries in the region. This classification is based solely on the duties performed, and the salary ranges are predicated on the salary surveys made by both the Society and the regional committee. The Metropolitan Section has adopted the committee's report in which is stated, "Salaries below the range specified in the foregoing schedule for any classification shall be regarded as inadequate and sub-standard."

Relief for Unemployed Engineers in New York Continues

A Résumé of Three Years of Work by the Professional Engineers' Committee on Unemployment and a Report on Activities Since October 1933

By ALFRED H. MEYER

EXECUTIVE SECRETARY, PROFESSIONAL ENGINEERS COMMITTEE ON UNEMPLOYMENT

IN October 1931, the local sections of the four Founder Societies in the metropolitan area of New York saw the necessity of providing special assistance to the unemployed engineers in the district, and formed an active committee to organize and administer relief. Since that time the committee has provided upward of 5,500 jobs; has raised and disbursed to needy cases over $185,000 contributed by members of the participating societies; and has supplied clothing, medication, fuel, food, and home and personal relief to more than 1,500 urgent cases. The money value of the employment found by the committee for those it has registered approaches $4,750,000. Best of all, it has replaced that helpless, hopeless feeling in many a competent engineer's breast—when he found himself out of work through no fault of his own and unable to supply his family with the bare necessities of existence—with a renewed interest in life and has raised his courage to face the future with assurance. The record of the cold facts in the report here presented does not tell half the story of either the dire need found or the appreciation of the economically harassed engineers in the New York metropolitan area who have received the help of the Professional Engineers' Committee on Unemployment.

Organized in October 1931 by the metropolitan sections of the four Founder engineering societies because it was the general opinion that the regularly constituted relief agencies did not amply provide assistance for the engineer, the Professional Engineers, Committee on Unemployment, locally known as the P.E.C.U., has carried on to the present, assisting not only the members of the engineering societies but all who could qualify as engineers. The work of the committee has been divided into logical subdivisions, and a brief account of each will be given.

REGISTRATIONS

The division on registrations has been particularly busy during the present year, partly because the work of the committee has become better known and partly because the Civil Works Administration (CWA) designated the P.E.C.U. as the official registration agency for all engineers. However, after the termination of the CWA on May 1, 1934, the registrations dropped to an average of approximately 100 per week, and as of October 1, 1934, they average 26 weekly. An analysis of the figures in Table I shows that the number of registrations for the last year exceeds that for any previous year in the existence of the committee. It is not believed, however, that this is because there is a greater number of unemployed, but because of the two conditions already stated. This is shown in the overwhelming increase in the numbers of non-members, while the registrations of members have decreased. All the registrations given in the tables here shown are new ones, because those who had registered in any previous year were not required to re-register.

TABLE I. TOTAL REGISTRATIONS

SOCIETY MEMBERSHIP	OCT. 1931 TO SEPT. 1932 INCL.	OCT. 1932 TO SEPT. 1933 INCL.	OCT. 1933 TO SEPT. 1934 INCL.	GRAND TOTAL	% TOTAL REGISTRATION BY SOCIETIES
American Society of Civil Engineers	240	340	291	871	9.4
American Society of Mechanical Engineers	357	516	309	1,182	12.8
American Institute of Electrical Engineers	212	259	154	625	6.8
American Institute of Mining and Metallurgical Engineers	35	49	22	106	1.1
Naval Architects	...	10	4	14	0.2
Former members	...	112	106	218	2.4
Non-members	1,349	1,729	3,131	6,209	67.3
Western Society of Engineers	4	...	...	4	...
Total	2,197	3,015	4,017	9,229	100.0

Among those who register daily, there are many high-grade men who are registering for the first time. In conversation it frequently develops that they have had full knowledge of the possibilities of help from the P.E.C.U. but that they have tried to "make their own way," and being at or near the end of their resources they are at last obliged to ask the committee to assist them.

RECORD OF PLACEMENTS

It is interesting to note that the total number of placements made by the P.E.C.U. in the three years of its existence is approximately 65 per cent of the total number registered during the same period. This of course includes both temporary and permanent placements, and some of the temporary placements have resulted in replacements. Actually, many more were placed during the first 8 months of the 1933–1934 fiscal year than registered. This was again due to the activities of the CWA. Approximately 2,800 men were engaged on this work, and permitted the P.E.C.U. to absorb by placement many of those it was unable to provide for during 1932 and 1933.

The closest cooperation between the P.E.C.U. and the Engineering Societies Employment Service has existed, and of the number of placements reported in Table II, the Employment Service has been responsible for approximately 250 men given permanent engineering work.

TABLE II. RELATION OF TOTAL REGISTRATION TO TOTAL PLACEMENTS

SOCIETY	OCT. 1931 TO SEPT. 1932, INCL.	OCT. 1932 TO SEPT. 1933, INCL.	OCT. 1933 TO SEPT. 1934, INCL.	GRAND TOTAL	PLACEMENTS AS % OF TOTAL REGISTERED	PLACEMENTS AS % OF REGISTRATION OCT. 1933 TO SEPT. 1934 INCL.
American Society of Civil Engineers	204	149	324	677	77.7	111.0
American Society of Mechanical Engineers	277	228	318	823	69.6	103.0
American Institute of Electrical Engineers	173	113	142	428	68.5	92.0
American Institute of Mining and Metallurgical Engineers	33	23	24	80	75.5	109.0
Naval Architects	..	4	4	8	57.1	100.0
Former members	..	36	99	135	61.9	93.0
Non-members	648	525	2,183	3,356	54.0	69.0
Western Society of Engineers	4	..	..	4	100.0	...
Total	1,339	1,078	3,094	5,511		

RAISING AND DISBURSING FUNDS

All the work of the P.E.C.U. has been made possible by voluntary contributions of the members of the societies and their friends. Every dollar that has been collected for this work has gone for relief. As shown in Tables III, IV, and V, it has been more difficult to obtain funds each year, but fortunately, by careful allocation of moneys during the first and second years of operation, it has been possible to carry on. Of the $109,803.00 collected during 1931–1932, $24,869.39 remained at the end of the year and was made available to the new executive committee. At the end of

1932–1933, $15,861.35 was available, which made it possible for the new committee to carry on.

TABLE III. NUMBER OF CONTRIBUTORS

SOCIETY	OCT. 1, 1931, TO SEPT. 30, 1932, INCL. (1)	OCT. 1, 1932, TO SEPT. 30, 1933, INCL. (2)	OCT. 1, 1933, TO SEPT. 28, 1934, INCL. (3)	PERCENTAGE OF TOTAL CONTRIBUTORS (1)	(2)	(3)
American Society of Civil Engineers	787	362	149	22.5	20.9	20.7
American Society of Mechanical Engineers	1,115	482	190	31.8	27.9	26.5
American Institute of Electrical Engineers	1,134	649	282	32.4	37.7	39.3
American Institute of Mining and Metallurgical Engineers	265	134	86	7.6	7.8	12.0
Non-members	202	97	11	5.7	5.7	1.5
Total	3,503	1,724	718	100.0	100.0	100.0

TABLE IV. TOTAL CONTRIBUTIONS BY YEARS

SOCIETY	OCT. 1, 1931, TO SEPT. 30, 1932, INCL. (1)	OCT. 1, 1932, TO SEPT. 30, 1933, INCL. (2)	OCT. 1, 1933, TO SEPT. 28, 1934, INCL. (3)
American Society of Civil Engineers	$ 34,577.38	$17,726.27	$ 6,780.41
American Society of Mechanical Engineers	25,312.60	12,229.46	7,005.15
American Institute of Electrical Engineers	22,522.62	14,230.66	5,948.25
American Institute of Mining and Metallurgical Engineers	12,222.47	6,008.38	3,306.00
Non-members	15,168.53	2,703.47	212.67
Totals	$109,803.60	$52,898.24	$23,254.48

TABLE V. AVERAGE AMOUNT PER CONTRIBUTOR

SOCIETY	OCT. 1, 1931, TO SEPT. 30, 1932, INCL. (1)	OCT. 1, 1932, TO SEPT. 30, 1933, INCL. (2)	OCT. 1, 1933, TO SEPT. 28, 1934, INCL. (3)
American Society of Civil Engineers	$43.90	$49.14	$45.51
American Society of Mechanical Engineers	22.67	25.37	36.86
American Institute of Electrical Engineers	19.84	22.16	21.09
American Institute of Mining and Metallurgical Engineers	46.12	44.82	38.47
Non-members	75.09	27.94	19.33
Average	$31.32	$30.63	$32.39

In these tables it is rather striking to note the tremendous drop in contributions received during the three years of operation, but it is also surprising to note that this drop has been entirely due to the number of contributors rather than the amount per contributor. The total amount per contributor has been practically the same. The accompanying tables showing the relation of the registrations, placements, and funds available, present a vivid picture of the great amount of work done by the committee with the comparatively small funds at its command.

In addition to the funds raised, as shown in Table IV, the Placement Division of the P.E.C.U. has been fortunate in finding employment for registrants with the various relief projects; that is, the different New York City committees and bureaus, county organizations in New York State as well as in New Jersey, and the more recent groups of the Civil Works Administration (Federal) and the temporary Emergency Relief Administration (State).

The amount of relief in dollar value may be shown in the following manner:

Wages paid to P.E.C.U. registrants by other relief organizations on relief work	$2,729,737.00
Wages paid to P.E.C.U. registrants in temporary and permanent engineering work	1,904,099.28
Wages paid on made work from P.E.C.U. funds	83,635.72
Grand total	$4,717,472.00

A financial statement for the period from October 1, 1933, to September 28, 1934, is given in Table VI.

TABLE VI. FINANCIAL STATEMENT FOR 1933–1934 AS OF SEPTEMBER 28, 1934

The actual receipts and disbursements for this year are as follows:

RECEIPTS:		
Balance on hand October 1, 1933	$15,861.35	
Cash received (including repaid loans)	24,029.98	
Total		$39,891.33
EXPENDITURES:		
Relief payments	$25,729.50	
Loans, 1933–1934	2,080.00	
Social service	3,858.25	
Total		31,667.75
Total cash reserve (balance)		$ 8,223.58

DIRECT LOANS MADE WHERE NECESSARY

From the beginning, the P.E.C.U. has assisted engineers in the form of loans. These have been made in accordance with need as shown by thorough investigation, and have been used where acute destitution has existed and placement could not be made immediately—for such purposes as to pay rent, to prevent evictions, and to delay the shutting off of gas and electric service. These loans are divided into two classes: (1) major, and (2) minor, or emergency. Under the first, after investigation, the recipient is required to sign a non-interest-bearing note, promising to repay the loan when possible.

Up to September 28, 1934, the total major loans amounted to $15,034.50, in which 259 society members and 121 non-members shared. To date 58 men have repaid $1,190.50, representing full or partial payments.

In addition, minor or emergency loans have been made in cases where an individual needed immediate assistance. These loans were in amounts of $3 maximum for non-members and $5 for members. No investigation was made and the signing of a note was not required. The total amount of emergency loans to date is $4,550, representing 155 loans to society members and 207 to non-members. Repayments made by 12 men total $136.

SOCIAL SERVICE RENDERED

The Division of Social Service is charged with the human side of relief including clothing, medication, hospitalization, and supplying of coal, food, home and personal relief. Mrs. E. L. Dolbear as director of this division, has been an indefatigable worker, as results have shown. During the three-year period, October 1, 1931, to October 1, 1934, 1,977 cases have been submitted to this committee for investigation and approval for relief. Of these cases, 1,563 were aided. For various valid reasons, the remainder received no aid. In many of the unaided cases the need was work, and this was promptly supplied in many cases through the Placement Division.

Supplies of food were originally obtained through the Red Cross, but when that source of supply was terminated, the P.E.C.U. appropriated $2,500 for food. Of this amount, $2,072.25 has been expended in relief to 341 families, benefitting 956 persons. The food supplied has been of good quality and of a balanced nature. In addition to the usual amount of such staples as flour and bread, fresh vegetables and fruits were supplied. Through the generosity of William Heyman, Assoc. M. Am. Soc. C.E., of the General Committee, shoes were furnished to approximately 314 children under 13 years of age, some children receiving, as necessity demanded, more than one pair.

A great deal of clothing has been distributed at the shop maintained at 487 Sixth Avenue, New York City, rent free, by courtesy of the Rhinelander Real Estate Corporation, through its manager, George A. Sherron, M. Am. Soc. C.E. In addition, much new clothing has been furnished; for example, 16 baby layettes and women's apparel of all kinds. Recent contracts were made with the New York City Department of Welfare, and through it bona fide relief cases have received immediate attention aud definite help.

Medical cases have numbered 127 and have been of a most varied nature: maternity cases, operations both major and minor, and state relief for mental defectives. Dental aid has been extended to 88 persons, and 72 cases have received treatment for eye trouble and various diseases.

In the miscellaneous aid that has been given are included the sending of a family to the parental home in Norway; the returning of men and families to their homes in other parts of the United States; and the obtaining of mothers' pensions.

Vote on Amendment to Code of Ethics

New York, N.Y.
December 14, 1934

To the Secretary
American Society of Civil Engineers:

The Tellers appointed to canvass the Ballot for Amendment to the Code of Ethics report as follows:

Total number of ballots received		4,243
Deduct:		
Ballots from members in arrears of dues	352	
Ballots without signature	15	
Ballots with illegible signature	1	
Ballots from members who have died since voting	2	
Total ballots not canvassed		370
Ballots canvassed		3,873
Deduct:		
Void ballots	11	
Blank ballots	7	
Total ballots not counted		18
Votes counted		3,855

"Shall the Code of Ethics be amended by the addition of the following paragraph:

"7. To use the advantages of a salaried position to compete unfairly with other engineers.' "

YES	3,152
NO	703
Total vote	3,855

Respectfully submitted,

J. J. HENNEBIQUE, *Chairman*

H. J. Krueger
Jacob Feld
Louis E. Robbe
Arthur B. Miller
Sol Pincus
Robert C. Dennett
Stewart I. Sherman
William R. Wolff
T. F. McQuade
E. M. Dwyer

Choosing the Paper for Civil Engineering Volume 5, 1935

DURING 1934 about 45 tons of paper went into the issues of CIVIL ENGINEERING, an amount costing in the neighborhood of five thousand dollars. Although this is not the major factor in the publication cost, it may be of interest to explain the steps taken in the selection of this essential item. To the unobserving eye no change may be apparent, but only a cursory comparison of this number with that of December 1934 will reveal a change for the better in the text paper.

It is to be noted that in CIVIL ENGINEERING there is a generous use of halftones, the medium used for the reproduction of photographs, as distinguished from line cuts, used to reproduce drawings. This fact determines the kind of paper needed, since the clear and effective printing of halftones calls for a smoother surface than the reproduction of line drawings. The best paper for halftones is a smooth-surfaced, "coated" stock similar to that which forms the cover of this number. On such a paper it is possible to use a halftone screen having 150 "lines," that is, rows of fine dots, to the linear inch. In fact, this is the screen that has been adopted for the cover illustrations. It enables the engraver to retain all the fine detail in a good photograph and in some cases actually to improve it by re-etching the high lights and burnishing the dark areas. Since for the text of CIVIL ENGINEERING such a stock is prohibitive in cost, its use is confined to the cover.

Fortunately, progressive paper manufacturers have studied and analyzed the qualities needed for the better reproduction of halftone illustrations in order to secure these results in a less expensive paper. In their "sized and super-calendered" paper they have developed a new "filler" to be incorporated in the paper pulp, to improve the surface. In addition this paper is super-calendered, that is, the drying paper during its manufacture is passed through a series of alternating hot steel and compressed paper rolls, those of each pair rotating at slightly different speeds so that a decided gloss, or ironed effect, is imparted to the surface. Such a surface lends itself to the use of a screen as fine as 133 lines per inch, and it is this general type of stock that has been used for the text of CIVIL ENGINEERING.

The new 1935 paper is also of the super-calendered type but of somewhat better quality than that previously used. Halftones printed on it will more nearly approach the fine results obtained on a coated stock. For selection of the paper to be used in 1935, ten of the leading paper companies submitted 67 different samples. Among these were samples of coated, super-calendered, and English finish, in various grades ranging from "A" to "E."

An English finish paper is one that is passed through pairs of hot steel rolls in its manufacture, and to the surface of which no gloss or ironed effect is imparted, because the rolls of each pair rotate at about the same speed. Because of its increased bulk, an English finish paper weighing 50 lb per ream of standard sheets gives an opacity equal to a sized and super-calendered paper weighing 55 lb per ream. Therefore the English finish paper has an advantage in price due to its lighter weight and to its slightly lower cost per pound. However, its somewhat rougher surface does not lend itself so satisfactorily to halftone reproduction. In its favor then are its softer, textbook surface, which is purportedly easier on the eye, and its lighter weight, implying also a saving in mailing costs. These were the advantages that had to be overbalanced in case another type of paper was selected.

Specifications adopted for the text paper set as a standard for CIVIL ENGINEERING considered the following characteristics: its substance, that is, the percentage of wood pulp, sulfite, soda, and old paper contained; its final thickness; its weight; its resistance to rupture and tearing; its elongation; its folding endurance; and its sizing, loading, ash, and opacity. According to these considerations, the required paper fell in the "B" grade, and the samples judged were generally of this grade, although papers in the "A" and "C" grades were not entirely disregarded. Judging the eligible papers from the standpoint of surface, opacity, color, and texture—the code price being fixed for all papers in the same grade—all but 12 of the samples submitted were eliminated. These 12 samples, 7 of them being sized and super-calendered and 5 English finish, were put in with the regular run of the November issue of CIVIL ENGINEERING and the printing qualities of each paper were then compared.

On careful study of these results, it was found that to use an English finish paper would require a change from a 133-line halftone screen to a 120-line. Some detail in the reproduction of halftones would then be lost and a lowering in the standard which CIVIL ENGINEERING has set in the past four years would result. For this reason further consideration of the English finish papers was abandoned in favor of the super-calendered papers. In the final analysis it was very difficult to choose from the seven printed samples of this type. The surface and opacity were found to be excellent in all of them and it was on the basis of color alone that the stock finally selected was chosen from a group of very fine papers.

It is then the color, or the increased whiteness, of the paper that will be most noticeable to the average reader when this January 1935 number is compared with the December 1934 number. Even the layman will note that the halftones are sharper and that the high lights are much brighter. Although the code regulations have imposed a slight increase in cost, this is more than offset by the better quality of the paper. It is thus that CIVIL ENGINEERING has started its fifth full year by appreciably raising the high standard already set.

Preview of Proceedings

The January issue of PROCEEDINGS *will contain several interesting articles on as many different subjects. The three papers definitely scheduled for this number deal, respectively, with the elastic properties of riveted connections, stresses in thick arches of dams, and the field verification of hydraulic laboratory tests.*

ELASTIC PROPERTIES OF RIVETED CONNECTIONS

IN A PAPER on "Elastic Properties of Riveted Connections," J. Charles Rathbun, M. Am. Soc. C.E., calls attention to the inconsistency of current assumptions in the design of steel frame buildings. For example, he points out that ordinarily the restraining effect of end connections is neglected, although in other problems of stress analysis in steel frames it is customary to treat the connections as being completely fixed or rigid. Designers have realized, of course, that end connections do provide some degree of restraint. However, they have had no means of knowing exactly how much allowance to make for it in a given case and, consequently, could not take advantage of any saving resulting from the resistance due to bending created by the connection. With this fact in mind, Professor Rathbun presents the results of tests to determine the degree of restraint required as well as a theoretical discussion with examples to demonstrate how the results of these tests may be utilized in current analytical design methods. Eighteen full-sized connections were tested.

In addition to indicating certain economies in design that can safely be effected, this paper also gives the engineer a more complete understanding of the action of standard beam connections and opens for consideration several problems. Approximately one-half of the paper is composed of photographs demonstrating the typical failures of various kinds of connections. These will be found interesting and instructive in interpreting the conclusions advanced by the author.

The paper is in two parts, of which the first is confined to a discussion of the elastic properties of the eighteen connections and to descriptions of laboratory tests on these specimens. The tests were divided into three groups or series: those with standard slip-angle connection; those with seat-angle connections; and finally a series of shallow wind-braced connections. The tests showed that the connections in the first series can be deformed through angles considerably greater than those ordinarily found without affecting their capacity to resist shear. One illustration shows a standard connection for an 8-in. I-beam which was used to demonstrate the effect of a double row of rivets in stiffening a connection. The effect of a second row of rivets in a standard connection for an 18-in. I-beam in this group is shown in a second illustration. A typical testing machine set up for the beams of the first series is also shown. Connections classed in the second group possess the same property in a smaller degree, but these also are capable of deformation within the working range. In the first two groups, deformations were due primarily to yielding in the angles rather than in the rivets or in the main members. The connections in the third group were comparatively rigid and were designed so that the manner of their failure could be controlled.

In the second part of his paper, Professor Rathbun demonstrates the methods of analyzing structural frames when consideration is given to the elastic properties of the connections. The possible saving resulting from utilizing the resistance of the connections in designing a simple beam is indicated.

The structural steel for these tests was furnished by the McClintic-Marshall Company, who fabricated the specimens. The tests were conducted in the Materials Testing Laboratory of the School of Technology, College of the City of New York, in cooperation with the American Institute of Steel Construction.

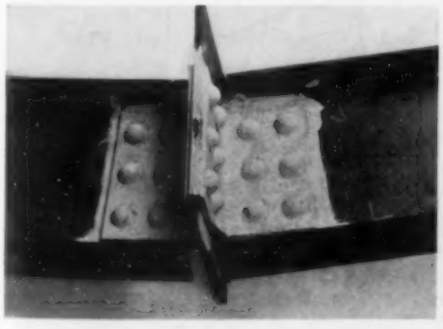
STRESSES IN THICK ARCHES OF DAMS

AN IMPORTANT point in the evolution of modern design theory in the field of arch dams is recognized in a paper by B. A. Smith, in Volume 83 of TRANSACTIONS, and in a paper by the late Fred A. Noetzli, M. Am. Soc. C.E., in Volume 84 of TRANSACTIONS. The late William Cain, M. Am. Soc. C.E., introduced his ideas on the subject in a paper published in Volume 85 of TRANSACTIONS, which has been a beacon in the field to all subsequent investigators of the subject. In 1928, the Society published a paper by Frederick H. Fowler, M. Am. Soc. C.E., which appears in Volume 92 of TRANSACTIONS and is entitled "A Graphic Method for Determining the Stresses in Circular Arches Under Normal Loads by the Cain Formula."

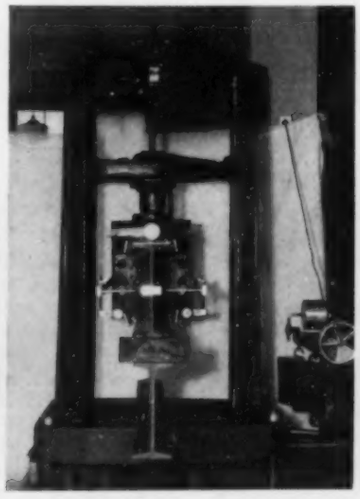
This latter article is the acknowledged inspiration of a forthcoming paper for PROCEEDINGS by Philip Cravitz, Jun. Am. Soc. C.E., entitled "Stresses in Thick Arches of Dams." This paper deals with another graphical solution of stresses in a circular arch under the influence of normal loads, its distinguishing feature being the inclusion of effects of yielding abutment. Furthermore, a finite value for Poisson's ratio is used rather than the infinite value previously assumed for simplification. The paper also includes an examination into the quantitative effect of variations in assumed values of the modulus of elasticity of rock and in Poisson's ratio. The curves presented in the paper are intended to demonstrate their use.

HYDRAULIC LABORATORY RESULTS AND THEIR VERIFICATION IN NATURE

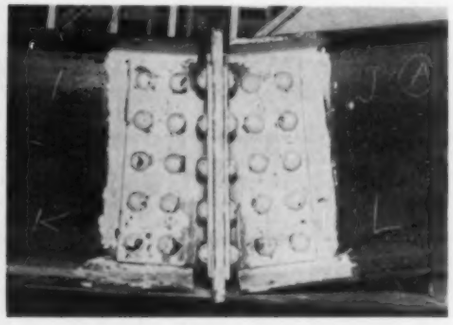
AT THE time of the 1934 Annual Meeting of the Society a particularly interesting and valuable paper on "Hydraulic Laboratory Results and Their Verification in Nature" was presented before the Waterways Division by Herbert D. Vogel, Assoc. M. Am. Soc. C.E. The scope of the paper is neatly defined in the broad question which opens the introduction, "What reliance can be placed by field engineers on the solution of river problems from model studies and what proof is there of the statement that a river will react to treatment the same as its miniature in a laboratory?" The answer is that the results of modern laboratory analysis of such problems are providing checks for practical field application every day. In this brief paper, the author has presented interesting descriptions of laboratory models and "case histories" of the actual behavior of structures in nature, as compared with that predicted from observations on the models themselves.



Typical Failure of Connection in Series A



Laboratory Set-Up for Testing Beams



Failure in an 18-In. I-Beam Connection

DETERMINING ELASTIC PROPERTIES OF RIVETED CONNECTIONS

American Engineering Council News

IN WASHINGTON, D.C., January 10–12, the American Engineering Council is to hold its annual meeting. It is important that organized engineers make themselves heard at this time, before the reconvening of Congress, when the 1935 program is being outlined. Some pertinent questions need answers. What part will engineers play as executives, planners, technical workers, and builders under the Government? What can they offer in the way of constructive criticism? What are the new responsibilities of engineers to the public?

The first day of the meeting, Thursday, January 10, is to be devoted to committee meetings of the Council and to conferences of the secretaries of the member societies. On Friday a group of officials of the major Federal units have been invited to appear before the Assembly of the Council for a frank discussion of their objectives, and the attitude of the Government toward engineering developments. These discussions will continue on Saturday, and the Council will undertake to develop continuing programs of activity. All sessions are to be held in the Pan-American Room of the Mayflower Hotel, starting at 10:00 a.m., January 10.

SURVEY OF ENGINEERING PROFESSION

The Labor Department's survey of the engineering profession is rapidly taking form. Questionnaires are to be sent out as soon as mailing lists are complete. In this connection, the secretaries of technical societies are urged to send in lists of their members at once—the names and addresses on 3 by 5-in. cards—to the Secretary of the American Society of Civil Engineers, 33 West 39th Street, New York, N.Y., who is preparing the master mailing list. It is naturally desired to complete and close this list at the earliest possible date.

"Checking up on the status of engineers is one of the steps toward a better understanding of the problems surrounding the professional and white-collar worker in general," said Dr. Isador Lubin, of the Bureau of Labor Statistics, under whose direction the survey is being made. "If anyone can make immediate and practical use of statistics, it ought to be the engineers. So we are seeking to provide some of the basic figures to this group . . . in order that they may analyze their problem without guesswork as to the actual trends and conditions."

A directory of 236 engineering societies—national, state, and local—has been compiled through questionnaires under the auspices of the American Engineering Council, the Engineering Foundation, and the Engineers' Council for Professional Development. The booklet, to be issued early in the year, includes names of officers, type and number of members, publications, dates of annual meetings, and other pertinent data. Copies may be ordered from the American Engineering Council, 744 Jackson Place, Washington, D.C., at cost, 50 cents each. Payment should be made in advance to save billing costs.

Appointments of Society Representatives

A. E. WINSLOW, Assoc. M. Am. Soc. C.E., represented the Society at the induction into office of Porter Hartwell Adams as president of Norwich University on October 22.

GEORGE E. BEGGS and LANGDON PEARSE, Members Am. Soc. C.E., have accepted appointments as Society representatives on the Board of the Engineering Foundation.

J. J. YATES, M. Am. Soc. C.E., will serve as a Society representative on the Board of the Engineering Societies Library.

News of Local Sections

CENTRAL ILLINOIS SECTION

On November 2 the Central Illinois Section held a meeting at Urbana, Ill. The guest speaker was J. L. Savage, chief designing engineer of the U. S. Bureau of Reclamation, who spoke on the technical features of the various dams throughout the country that are being constructed by the Bureau of Reclamation. About 47 members and guests were present, and an informal discussion followed the lecture.

CINCINNATI SECTION

On December 3 the Cincinnati Section held a meeting at the Engineers Club. At the conclusion of the business session, George E. Shafer, engineer of tests for the Armco Culvert Manufacturers Association, addressed the gathering. His talk on the technical development, and use, of heavy gage corrugated plates in the construction of small bridges was well illustrated and proved highly interesting. About 30 members and visitors were present.

CLEVELAND SECTION

The October meeting of the Cleveland Section was held on October 5 at the Cleveland Chamber of Commerce, with 48 in attendance. Among the speakers were J. S. Gena, assistant chief engineer for the Muskingum Valley Watershed and Conservancy District in Ohio, and Prof. George E. Barnes, in charge of the spillway design of the 14 dams in the district. When the meeting adjourned, the members were conducted through the laboratories of the Case School of Applied Science to see some tests on model dams. At a meeting of the Section held on December 4 the following officers were elected: James H. Herron, president; Charles H. Splitstone, vice-president; and Arthur Blaser, secretary-treasurer.

GEORGIA SECTION

On November 5 the Georgia Section held a large and successful meeting. The speaker of the occasion was Sherman M. Woodward, consulting engineer for the Tennessee Valley Authority, who talked on various aspects of the construction of Norris Dam and exhibited 30 interesting slides in connection with that work. There were 101 members and guests present at dinner, and about 115 at the lecture. Many were turned away at the door because of lack of seating facilities.

ILLINOIS SECTION

A number of interesting luncheon meetings were enjoyed by the Illinois Section during the fall. Some of the topics discussed at these gatherings were "Development of Chicago Sanitary District Projects," by Joshua D'Esposito; "Currency Stabilization," by James W. Bell, of Northwestern University; "Federal Emergency Housing Corporation," by Horatio B. Hackett; "Registration of Civil Engineers," by H. E. Babbitt; and "Economic Planning," by Ralph Heilman, of Northwestern University.

IOWA SECTION

The sixteenth annual meeting of the Iowa Section was held in Des Moines on November 15. The speaker at the afternoon session was Q. C. Ayres, of Iowa State College, who discussed the subject, "Engineering Phases of Soil Conservation." Then A. H. Fuller outlined the latest developments in the Engineers' Council for Professional Development. At the evening session A. H. Wieters, chief of the Division of Sanitary Engineering of the Iowa State Department of Health, gave an address on "Stream Pollution in Iowa and Attendant Sanitary Problems." The following officers were elected for the coming year: C. C. Williams, president; R. A. Caughey, vice-president; and R. B. Kittredge, secretary-treasurer.

PHILADELPHIA SECTION

An unusual meeting of the Philadelphia Section was held on November 19 at the Engineering Building of the University of Pennsylvania. Dinner was served in Houston Hall to 78 members and guests, while 136 came in for the meeting later. After dinner the members were divided into four groups for a tour of the laboratories. Among the speakers were Francis P. Witmer, director of the department of Civil Engineering; H. C. Berry, Professor of Materials of Construction at the university; and A. C. Bates, of the Department of Mechanical Engineering. The members took advantage of the invitation to ask questions, and the evening proved to be both interesting and instructive.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for February

Through the cooperation of the officers of the Los Angeles Section of the Society a notable group of four articles on the construction of the Colorado River Aqueduct by the Metropolitan Water District of Southern California is in prospect for the February issue. This $220,000,000 project is progressing rapidly all along the route from the Parker Diversion Dam on the Colorado River, through the tunnels under the peaks of the San Jacinto Mountains, to the terminal distribution tunnels along the foothills of the Sierra Madres. The subject is to be treated from the standpoint of financing, design, and construction, both by force account and by contract. The authors are F. E. Weymouth, Julian Hinds, J. L. Burkholder, Members Am. Soc. C.E., and J. C. Agnew, general manager of the Winston Brothers Company, contractors on the East Iron Mountain Tunnel.

Two more huge current engineering projects are to be described in the February issue. Both of them are on the Columbia River—the Grand Coulee Dam and the Bonneville Dam. These will be described from the viewpoint of the geologist by Charles P. Berkey, M. Am. Soc. C.E. As close as they may be to each other geographically, the conditions influencing their foundations are far different geologically. It is probably not realized that Bonneville Dam is being built under most exacting geological conditions, fully as puzzling as those which faced the constructors of Boulder Dam. Nor is it fully appreciated, perhaps, that the Grand Coulee Dam when built to its full height will be larger than Boulder Dam. Dr. Berkey's interpretation of the geological structures at these two sites will be of absorbing interest to both geologists and engineers.

As a student of water supply derived from surface and underground sources in the western part of the United States, S. T. Harding, M. Am. Soc. C.E., has collected data on the variation in level of numerous lakes in the Great Basin. His data go back as far as 1650, and his purpose is to study the past variations in climate in an attempt to discover a general trend in variation in rainfall that may be assumed for the future. Where actual measurements of lake levels were not available, a search was made of the diaries of explorers and engineers. Also the discovery of stumps of trees killed by submergence, which are now beneath the lake surface, has aided in extending the record backward. His data, which go back as far as 1650, permit conclusions of great value.

There is also an article by Carlton S. Proctor, M. Am. Soc. C.E., on the foundations for the East Bay Crossing of the Trans-Bay Bridge at San Francisco.

A. S. M. E. Names National Secretary

At a recent meeting of the council of the American Society of Mechanical Engineers, Clarence E. Davies was appointed national secretary of that society, to succeed the late Dr. Calvin W. Rice, whose death in October 1934 was noted in these pages. The death of Dr. Rice terminated his 27 years of active service as the national secretary and left a gap in the leadership of the society and in its headquarters organization that has been difficult to fill.

Nevertheless the council of the society did not find it necessary to go far to find a

C. E. Davies, Secretary of American Society of Mechanical Engineers

capable and competent appointee. In fact, Mr. Davies had been "educated" in the work by Dr. Rice himself, on whose staff he had served for nearly 15 years. In 1931 Mr. Davies was appointed executive secretary and as such has been in charge of the administration of the headquarters office. Now the offices of secretary and executive secretary are combined.

After graduating from Rensselaer Polytechnic Institute in 1914, Mr. Davies began his professional career in the production department of the Remington Typewriter Company. During the War, he served in the Ordnance Department, U. S. Army, and was assigned to the Frankford Arsenal on the manufacture of artillery, ammunition, and fuses. He now holds the rank of lieutenant colonel in the Ordnance Reserve Corps and participates actively in the organization and operation of the New York Ordnance District.

It was in 1920, when he was appointed associate editor, that Colonel Davies began his connection with the American Society of Mechanical Engineers headquarters staff. A year later he became managing editor and assistant secretary, and in 1931 was appointed executive secretary.

In addition to his purely society duties, Colonel Davies has been active in the Engineers' Council for Professional Development and in 1934 was made its first secretary. He is honorary corresponding secretary for North America of the Newcomen Society (England) for the Study of the History of Engineers.

New Home Dedicated by Providence Engineering Society

Forty years ago a small group of engineers founded an organization known as the Providence (R.I.) Association of Mechanical Engineers. By 1915 the membership had grown to 195. It was during that year that final action was taken to broaden the scope of the organization's activities so as to include in the membership, engineers of the other branches of the profession. The Providence Engineering Society, then formed, has grown steadily to its recent peak of 1,250 members. Continued interest in the new society has been indicated by increased attendance at the meetings, which meant that more commodious quarters were needed.

On November 29, 1934, a permanent new home for the society, purchased with funds that have been accumulated over a period of years for the purpose, was dedicated. Favorable real estate conditions made it possible to obtain a two-story brick building at 195 Angell Street which had been occupied formerly by the New England Telephone Company. Considerable repairing and remodeling had to be undertaken at extra expense. Rental of the first floor for offices provides an income sufficient to cover operating expenses, and the second floor forms quarters for the society. Here there is an auditorium seating about 300 people, and a beautiful library and lounge.

On a brass plate below the mantle in the library is the following inscription: "Each man is a debtor to his profession; therefore it seems fitting that when one's profession has given lifelong happiness and a competence he give token of his appreciation of this indebtedness to those who have gone before and give friendly encouragement to those coming along." The initials "J. R. F." are appended to this inscription.

At the dedicatory exercises, the 300 members and guests assembled greeted with hearty applause the simple statement of Clarke Freeman, son of the late John R. Freeman, that the building and all its

furnishings were free of debt. Through the generosity of Mr. Freeman's family the mortgage and all outstanding bills were paid off, and the library with its splendid furnishings was donated. Books taken from Mr. Freeman's personal collection of technical works occupy six shelves and form the nucleus for the society's library.

The Providence Engineering Society will now have an increased opportunity for its diversified group of members to develop like interests, exchange ideas, make new friendships, and aid both the young and old in the profession to keep abreast of developments in their chosen field. The new home of the Providence Engineering Society provides a splendid meeting place for the local sections of the Founder Societies, among them the Providence Section of the American Society of Civil Engineers.

It will be remembered that John R. Freeman served the Society as President in 1922 and was elected to Honorary Membership in 1930. He was also a former president and an honorary member of the Providence Engineering Society.

Employment of Engineers in the United States

AN INTENSIVE study of the U. S. Census for 1930, made by the American Engineering Council, reveals that in that year there were 225,800 who called themselves engineers, forming 0.46 per cent of the total of 48,830,000 gainfully employed. One engineer was listed for every 500 of population, and one for every 210 persons gainfully employed. The distribution of the engineers by professional classes was as shown in Table I. The fact that the total membership in technical societies was but 115,000 in 1929 indicates that minor technicians were probably included in the census total.

TABLE I. DISTRIBUTION OF ENGINEERS IN THE UNITED STATES

By Professional Classes, According to U. S. Census of 1930

CLASS	NUMBER	PER CENT
Civil	101,946	45.1
Electrical	57,735	25.6
Mechanical	54,264	24.0
Mining	8,408	3.8
Chemical and Metallurgical	3,434	1.5
Total	225,787	100.0

TABLE II. DISTRIBUTION OF ENGINEERS, BY EMPLOYMENT GROUPS

GROUP	NUMBER	PER CENT
Agriculture	625	0.3
Forestry	708	0.3
Extraction industry	7,730	3.4
Communication	13,211	5.9
Public utilities	13,700	6.1
Building industry	16,490	7.3
Transportation	29,349	13.0
Industry and trade	65,383	28.9
Total of industrial groups	147,256	65.2
Government service	24,890	11.0
Professional and consulting engineers	53,641	23.8
Grand total	225,787	100.0

Although 65 per cent of the engineers were listed as employed by industry and commerce, it should be noted that some industries employed practically no engineering talent. From a study of Table II it appears that the future of the engineering profession is still in the field of private industry and that a real opportunity lies in the development of backward industries.

A profession-wide survey is now under way by the Bureau of Labor Statistics to determine how the status of engineers has changed since the last Federal Census was taken. The results are expected to answer some of the questions as to where the greatest demand for engineers exists, and to determine whether engineering schools are graduating too many engineers in some branches of the profession and not enough in others. This census and survey is being undertaken by Dr. Isador Lubin, Commissioner of Labor Statistics, cooperating with national, state, and local engineering societies through the American Engineering Council.

Inventory of Real Property Completed

A SURVEY or inventory of residential properties in 64 cities, representing a cross section of the conditions in every state in the Union, has recently been completed. The work was financed by the Civil Works Administration and gave employment last winter to thousands of otherwise unemployed white-collar workers throughout the country.

The inventory was conducted and the statistics were gathered by the Bureau of Foreign and Domestic Commerce of the Department of Commerce under the guidance of the U. S. Census Bureau. The method used was house to house inquiry regarding the condition of the structures and their facilities. The list of questions used was selected by experts in the building industry in collaboration with representatives of the building and construction fields, with manufacturers of building materials, plumbing and heating equipment, and household equipment, and with architects.

An epitome of the detailed reports from the 64 cities in which the surveys were conducted last winter has been prepared by the Private Housing Committee of the Business Advisory and Planning Council. It indicates in a general way the need for modernizing the homes of the country. Those engaged specially in city planning and civic development, as well as those connected with the construction and maintenance of buildings and the manufacture and distribution of appliances should find considerable interest in the information obtained in the survey. Some of the more interesting facts and figures follow. The dwellings considered in this inventory are those which come under the head of private homes; apartments and tenements are excluded. Thus 85.8 per cent of the structures are occupied by single families; 8.8 per cent, by two families; and the remaining 5.4 per cent, by three families or more. The survey first considers the condition of the buildings, as outlined in Tables I, II, and III.

TABLE I. AGE OF BUILDINGS

PER CENT	AGE IN YEARS
1	Over 75
5	50 to 75
7	40 to 50
13.5	30 to 40
17.8	20 to 30
26.4	10 to 20
20.2	Under 10

TABLE II. SIZE OF BUILDINGS

PER CENT	NO. OF ROOMS
14.8	3
19.4	4
24.2	5
16.7	6

TABLE III. CONDITION OF BUILDINGS

PER CENT	CONDITION
2.4	Unfit for habitation
16.6	In need of structural repairs
44.0	In need of minor repairs
36.7	In good condition

It is also noted that 79 per cent of the houses are of wood, 12.5 per cent of brick, and the remainder of stone, concrete, stucco, and miscellaneous material. The largest percentage of buildings falls in the group of 10- to 20-year-old houses. Moreover, only 36.7 per cent are in good condition, the remainder ranging from those needing minor repairs to those completely unfit for habitation.

Considering next the families that inhabit the buildings, it is found that the largest percentage are occupied by families of only two persons, and in addition the greater number of these families have been in occupancy for less than six months, as shown in Tables IV and V.

TABLE IV. NUMBER IN FAMILY

PER CENT	NO. OCCUPIED
25.0	2 persons
23.0	3 persons
19.0	4 persons
11.8	5 persons
8.3	Extra family (result of doubling up)

TABLE V. TIME OCCUPIED

PER CENT	TIME
6.7	20 years and over
14.0	10 to 20 years
16.0	5 to 10 years
25.0	Less than 6 months

This apparently high degree of transiency among householders may be explained by the fact that only 38 per cent of them owned their homes, and that only 43.4 per cent of the houses were unmortgaged. A further idea of the economics of the situation may be gained from the following Tables VI and VII, giving the value of the dwellings and the rentals obtained. Only 7 per cent of the buildings were unoccupied.

TABLE VI. VALUE OF BUILDINGS

PER CENT	VALUE
10.0	Under $1,000
17.0	$2,000 to $3,000
23.0	$3,000 to $5,000
12.6	$5,000 to $7,500

TABLE VII. RENTALS OBTAINED

PER CENT	RENTAL PER MONTH
19.7	Under $10
19.7	$10 to $15
16.8	$15 to $20
23.0	$20 to $30
15.0	$30 to $50

In an effort to gage the standard of living within these homes, the method of heating was recorded. It was found that 62 per cent were heated by stoves and 18.8 per cent by hot air. While 62.5 per cent had both hot and cold water, 26.9 per cent had only cold water, and 22.3 per cent were without water closets. Electricity was used in 86.2 per cent, but only 16.9 per cent had mechanical refrigeration. Cooking ranges were found in 69.3 per cent. Vegetable gardens were attached to 21 per cent of the homes. It is interesting to note that while only 77.7 per cent had water closets, 61.3 per cent had garages of some kind. However, only 34.3 per cent of the families used automobiles, while 29.4 per cent walked and 9.8 per cent used street cars as a means of transportation.

These data cover 42 out of the 63 cities studied and include 18,587 dwelling units. In the further survey, including 64 cities, totaling 2,633,000 dwelling units, 9,074,786 persons were found. In 30 metropolitan districts 177,000 buildings were vacant out of a total of 2,235,151. And in 33 cities not in metropolitan centers, there were found to be 204,000 vacant dwellings out of 2,633,135.

NEWS OF ENGINEERS

From Correspondence and Society Files

JOHN E. ALLEN has accepted the position of structural engineer with the Power and Irrigation Division of the U. S. Engineer Office, Missouri River Division, with headquarters in Kansas City, Mo.

ERLE L. COPE is now superintendent of the Bureau of Building Inspection of the City and County of San Francisco.

M. P. ANDERSON has severed his connection with the Tennessee Valley Authority at Norris, Tenn., to become associated with the Mason-Walsh-Atkinson-Kier Company, contractors on the Grand Coulee Dam in Washington.

T. Y. LIN has been transferred from the Tientsin Pukow Railway to the Ministry of Railways of the Chinese National Government.

ROBERT J. JENKS is now employed as a draftsman by the Mason-Walsh-Atkinson-Kier Company, contractors on the construction of the Grand Coulee Dam in Washington.

CHESTER K. WENTWORTH has resigned as Associate Professor of Geology at Washington University, St. Louis, Mo., to accept the position of geologic engineer with the Board of Water Supply of Honolulu, Hawaii.

VICTOR J. BEDELL has been promoted from the position of valuation engineer for the New Orleans Public Belt Railroad to that of chief engineer of the same railroad. His headquarters are in New Orleans, La.

RICARDO FERNÁNDEZ PERALTA, until recently engineer inspector of the municipal works of San José, Costa Rica, has been appointed chief engineer of the San José municipality on sanitation and paving works.

EDWARD T. HAAS has resigned as associate editor of the Life Publishing Company to become assistant executive for the Haas, Doughty and Jones Construction Company on the construction of the Loup River Public Power Project.

RAMÓN GELABERT D'ELIAS, formerly assistant engineer and superintendent of buildings of the American Railroad Company of Puerto Rico, has been appointed general manager of the Soller Sugar Company, with headquarters at Arecibo, Puerto Rico.

Changes in Membership Grades

Additions, Transfers, Reinstatements, Deaths, and Resignations

From November 10 to December 9, 1934, Inclusive

ADDITIONS TO MEMBERSHIP

ANDERSON, ARTHUR ROLAND (Jun. '34), Box 30, Mass. Inst. Tech. Dormitories, Cambridge, Mass.

ANDERSON, MAYNARD MARION (Jun. '34), Junior Engr., Met. Water Dist. of Southern California, Berdoo Camp, Indio, Calif.

ANDRUS, LYNN THORPE (Assoc. M. '34), Bridge Designer, State Highway Comm. (Res., 1007 Wilson Ave.), Ames, Iowa.

BARNES, MARIAN EUGENIA (Miss) (Jun. '34), 513 Spruce St., Trinidad, Colo.

BERGMEISTER, CHARLES NICHOLAS (Jun. '34), 638 Fulton St., Elizabeth, N.J.

BERNSTEIN, M. JACK (Jun. '34), 7100 South Shore Drive, Chicago, Ill.

BIRD, JOHN MACBETH (Jun. '34), Care, Soil Erosion Service, High Point, N.C.

BJORKLUND, WALTER RAGNAR (Jun. '34), With Asst. Engrs. Office, N. P. Ry., Tacoma (Res., 5716 Woodlawn Ave., Seattle), Wash.

BLAKEMORE, WILLIAM ALLEN (M. '34), Chf. Engr., Gulf Production Co., P.O. Drawer 2100, Houston, Tex.

BLOUNT, GEORGE COCHRAN (Jun. '34), Transitman, State Highway Dept., Hereford, Ariz.

BLUNT, ALLYN WILLIS (Assoc. M. '34), Res. Engr., San Gabriel Dam No. 2, Los Angeles County Flood Control Dist., 913 East Maple, Glendale, Calif.

BOLON, HARRY CLOYD (Assoc. M. '34), Asst. Engr., U. S. Geological Survey, Box 64, Rolla, Mo.

BOSLAND, FRANK EVERET (Jun. '34), 292 North 8th St., Paterson, N.J.

BROOKS, ROBERT BLEMKER, JR. (Jun. '34), 1517 Mart Bldg., St. Louis, Mo.

TOTAL MEMBERSHIP AS OF DECEMBER 9, 1934	
Members	5,703
Associate Members	6,083
Corporate Members	11,786
Honorary Members	20
Juniors	3,003
Affiliates	100
Fellows	4
Total	14,913

BROSCH, CARL WILLIAM (Jun. '34), Brandywin Summit, Pa.

BROWN, ROBERT HORACE (Jun. '34), Instrumentman, State Planning Board; Care, Grove Brown, Route 3, Missouri Valley, Iowa.

BUOB, MILFORD EDWARD (Jun. '34), 1092 Sanford Ave., Irvington, N.J.

BURKS, WILLIAM S., JR. (Jun. '34), 978 North 52d Pl., Birmingham, Ala.

BURNETT, KNOX FOLSOM (Assoc. M. '34), Structural Designer, Platte Val. Public Power and Irrig. Project (Res., 800 West 6th St.), North Platte, Nebr.

BURNSON, BLAIR IRVING (Jun. '34), 2079 Oakland Ave., Piedmont, Calif.

BUTTMI, WILLIAM WALLACE (Jun. '34), 2178 Tiebout Ave., New York, N.Y.

CASSELL, DAVID BENNETT, JR. (Jun. '34), Care, West Slope Constr. Co., Box 146, Azusa, Calif.

CASSESE, SALVATORE (Jun. '34), 1574 East 36th St., Brooklyn, N.Y.

CHOSNEY, THEODORE STANLEY (Jun. '34), 538 South 13th St., Newark, N.J.

CHRISTOFIDES, COSTAS (Jun. '34), 881 Westchester Ave., Apartment 10, New York, N.Y.

CLARK, CYRIL MESMAN (Jun. '34), Ontonagon, Mich.

CORTELYOU, JOHN TAYLOR (Jun. '34), 1755 West 39th St., Los Angeles, Calif.

CREIGHTON, SAMUEL JAMES, 3d (Jun. '34), 19 Mildred St., Crafton, Pa.

CRUMPACKER, HAROLD CHESTER (Jun. '34), 1121 Riverside Drive, South Bend, Ind.

CULVERN, FREDERICK EUGENE (Jun. '34), 210 Ransom St., Chapel Hill, N.C.

DALZELL, CHESTER LAWTON (Jun. '34), Engr., John B. Pierce Foundation, 40 West 40th St., New York (Res., 22-20 Twenty-seventh St., Long Island City), N.Y.

DAMES, TRENT RAYSBROOK (Jun. '34), 835 South Oxford Ave., Apartment 206, Los Angeles, Calif.

DASHIELLS, JOHN LESTER (Jun. '34), 223 East 33d St., Baltimore, Md.

DERRICK, CLARENCE JOSEPH (M. '34), Cons. Engr., 816 West 5th St. (Res., 2021 Kenilworth Ave.), Los Angeles, Calif.

DIBBLE, JOHN TAYLOR (Jun. '34), 802 West 3d St., Sterling, Ill.

DI LORENZO, ANTONIO VINCENT CARMINE (Jun. '34), 555 Tenth St., West New York, N.J.

DOBBS, MELVIN ARTHUR (Jun. '34), Asst. Engr., State Water Survey, Urbana, Ill.

DONOVAN, MAURICE VINCENT (Jun. '34), 503 East 87th St., New York, N.Y.

DOUTY, JAMES FREDERICK, 3d (Jun. '34), 4202 Maine Ave., Baltimore, Md.

DYER, VALENTINE EDWARD (Jun. '34), 17 Valley Rd., Clifton, N.J.

ELKOW, MILTON OMELIAN (Jun. '34), 125 Rogers Ave., Brooklyn, N.Y.

ELLIS, RICHARD HENRY (M. '34), Director of Public Works, Newton (Res., 37 Halcyon Rd., Newton Center), Mass.

ERSKINE, ROBERT MACNEE (Jun. '34), 39 Third St., Weehawken, N.J.

EVANS, DAVID WILL (Jun. '34), 5431 Wayne Ave., Chicago, Ill.

FORD, CURRY ELLISTON (Jun '34), San. Engr., State Planning Board (Res., 665 Y. M. C. A.), Columbus, Ohio.

FRINGER, DAVID LEWIS BARTLETT (Assoc. M. '34), Prin. Examining Engr., Maryland Civ. Works Administration-Emergency Relief Administration (Res., 15 West Chase St.), Baltimore, Md.

FROMM, AUGUST GEORGE (Jun. '34), 1312 Clay Ave., New York, N.Y.

GENTRY, DONALD GEORGE (Jun. '34), Box 1227, Agri. and Mech. Coll. of Texas, College Station, Tex.

GOLLY, MILLIS RAY (Jun. '34), 201 Cooper St., Peoria, Ill.

GRADY, JAMES ARTHUR (Jun. '34), Engr., E. I. du Pont de Nemours and Company, 700 West 27th St., Richmond, Va.

GRIFFIN, DONALD FRANCIS (Jun. '34), 370 North Mariposa Ave., Fresno, Calif.

GROSS, MILTON HENRY (Jun. '34), 854 Kelly St., New York, N.Y.

HAMILTON, GORDON HAROLD (Assoc. M. '34), Gen. Supt., W. A. Ross Constr. Co. (Res., 1263 Stratford Rd.), Kansas City, Mo.

HARBER, WILLIAM GLOVER (Jun. '34), R. F. D. 1, Albany, Ore.

HERSH, MARVIN (Jun. '34), Engr. and Supt. of Constr., Hersh Const. Co. (Res., 2670 North Grant Boulevard), Milwaukee, Wis.

HESSELMEYER, HARRY LEONARD (Jun. '34), Observer, U. S. Coast and Geodetic Survey, 734 Melville Ave., Palo Alto, Calif.

HILTZ, JOHN PHILIP, Jr. (Jun. '34), 3512 Bank St., Baltimore, Md.

HOGE, GEORGE JAMES (Jun. '34), Dayton, Wyo.

HYDE, GEORGE EMMONS (Jun. '34), 3734 Binkley St., Dallas, Tex.

JERVIS, WILLIAM HORACE (Jun. '34), Chf., Soils Section, Vicksburg Engr. Dist. (Res., 3508 Washington St.), Vicksburg, Miss.

JEWETT, GEORGE EDGAR (Jun. '34), Camp 73-P E, Box 36, Waterloo, Ill.

JOHNSON, BAILEY WILLIAMS (Jun. '34), Chf. Engr., Temporary Emergency Relief Bureau, City Hall; 118 Lakeview Ave., Jamestown, N.Y.

JOHNSON, ROBERT SOLOMON (Jun. '34), Canaan, N.Y.

JOHNSON, SAMUEL YORKS (Jun. '34), 2301 Mar Vista Ave., Pasadena, Calif.

JONES WILLIAM PENN (Jun. '34), Junior Structural Engr., National Aniline & Chemical Co., Inc., 351 Abbott Rd. (Res., 45 West Mohawk St.), Buffalo, N.Y.

JONSSON, ALEX CARL (Jun. '34), With Met. Water Dist. of Southern California, Indio (Res., 2259 Wellesley Ave., West Los Angeles), Calif.

JORDAN, EDWARD CLARENCE, 2d (Jun. '34), 21 Lincoln St., Portland, Me.

KARATHANASIS, NICHOLAS (Jun. '34), Chf. of Party and Topographical Draftsman, Dept. of Markets, Weights and Measures, City of New York (Res., 164 East 33d St.), New York, N.Y.

KEITH, WARREN GRAY (Jun. '34), With Lyon County Highway Dept., Marshall, Minn.

KELLER, JOHN HARRINGTON (Jun. '34), 105 South 17th St., Terre Haute, Ind.

KERSTEN, MILES STOKES (Jun. '34), Care, Civ. Eng. Dept., Univ. of Minnesota, Minneapolis, Minn.

KNOX, VERNON EUGENE (Jun. '34), 1172 Stratford Ave., New York, N.Y.

LAMBERT, WILLIAM BRAUND (Jun. '34), 31 Hammel Ave., Webster Groves, Mo.

LAMBRIGHT, JOHN SHERMAN (Jun. '34), Care, State Highway Comm., 4th Floor, State House Annex, Indianapolis, Ind.

LAWSON, WILLIAM WHITELAW (Jun. '34), Box 30, Watch Hill, R.I.

LAWTON, WARREN LEIGH (Jun. '34), The Shelton House, Dupree, S. Dak.

LOWY, FREDERICK CHARLES (Assoc. M. '34), 440 West 34th St., New York, N.Y.

LUETZELSCHWAB, EDGAR JOHN JACOB (Jun. '34), 508 East Springfield, Champaign, Ill.

MCALLISTER, JAMES SAMUEL (Jun. '34), Care, Mason-Walsh-Atkinson-Kier Co., Coulee Dam, Wash.

MAGUIRE, CHARLES AUGUSTINE (Assoc. M. '34), Chairman, Met. Sewer Comm., State of Rhode Island; Commr. of Public Works, City Hall (Res., 310 Elmgrove Ave.), Providence, R.I.

MASON, DRAPER COOLIDGE (Jun. '34), 2135 North East 16th Ave., Portland, Ore.

MILLER, HERBERT WILFRED (Jun. '34), Draftsman and Designer, Dist. IV, Div. of Highways (Res., 1405 Van Ness Ave., Apartment 700), San Francisco, Calif.

MILNER, WALKER WILSON (Jun. '34), 2d Lieut., Corps. of Engrs., With 13th Engrs., Fort Humphreys, Va.

MOONEY, EARL ELLSWORTH (Jun. '34), 40 Clark St., Lynn, Mass.

MOORE, FRANK HARDY, Jr. (Jun. '34), Computer, Valuation Dept., P. R.R., Philadelphia (Res., 211 Walnut Ave., Wayne), Pa.

MOURSUND, ANDREW FLEMING (M. '34), Div. Engr., State Highway Dept., Box 908, San Angelo, Tex.

NAUGHTEN, MALACHY JOSEPH (M. '34), Constr. Engr., Patrick McGovern, Inc., 50 East 42d St., New York (Res., 1910 Homecrest Ave., Brooklyn), N.Y.

NEW, WILLIAM (Jun. '34), Waynesville, N.C.

NEWMARK, NATHAN MORTIMORE (Jun. '34), 119 Materials Testing Laboratory, Univ. of Illinois, Urbana, Ill.

NICHOLS, KENNETH DAVID (Jun. '34), Lieut., Corps of Engrs., U.S.A., Care, The U. S. Military Attaché, 30 Tiergartenstrasse, Berlin, Germany.

NOLLIS, KENNETH JOHN (Jun. '34), Box 554, Trail, B.C., Canada.

PARRISH, KARL CALVIN, Jr. (Jun. '34), Care, Parrish & Co., Barranquilla, Colombia.

PERRY, DAVID JUNIOR (Jun. '34), 705 South Division St., Ann Arbor, Mich.

PIPER, JAMES DICKINSON (Jun. '34), 1215 West York, Enid, Okla.

PORTER, ARZA FRANCIS (Jun. '34), 465 West Center St., Covina, Calif.

PRICE, TREVOR ALARIC PRYCE (Jun. '34), Candia, N.H.

QUARTLY, ERIC VERNON ASHTON (Jun. '34), Junior Partner, Allen & Rowe, 309 G St., San Diego, Calif.

REEDER, JACK GRAYDON (Jun. '34), 1112 West Illinois St., Evansville, Ind.

RICH, WILLIAM THOMAS (Jun. '34), 353 West Water St., Elmira, N.Y.

RIMBAY, JOSEPH JOSLYN (Jun. '34), Richland County Engr., 518 North 3d St., Wahpeton, N. Dak.

ROPER, JAMES HUNTER (Assoc. M. '34), 895 Longridge Rd., Oakland, Calif.

SCHAILL, HAROLD ARTHUR (Jun. '34), 1520 Cambridge Rd., Ann Arbor, Mich.

SCHELL, JOHN FLOYD (Jun. '34), R. R. 7, Iowa City, Iowa.

SCHONECK, WILLIAM JOHN (Assoc. M. '34), Asst. Lighthouse Engr., (Res. 1415 Division St.), Key West, Fla.

SCROGGIE, EVERETT (Assoc. M. '34), Asst. Structural Engr., Tennessee Val. Authority (Res., 1502 Forest Ave.), Knoxville, Tenn.

SIMPSON, WILLIAM PHILIP (Jun. '34), 308 West South St., Salina, Kans.

SLUDER, DARRELL HAYES (Jun. '34), 1408 South 7th St., Alhambra, Calif.

SMELSER, PAUL EDWARD (Jun. '34), 424 Housten St., St. Charles, Mo.

SMITH, CARNEAL KIRBY (Jun. '34), 7413 Bertha Ave., Brooklyn Station, Cleveland, Ohio.

SMITH, DONALD ELLIOTT (Jun. '34), 56 East 7th St., Oswego, N.Y.

SNYDER, FRANKLIN FARISON (Jun. '34), Junior Engr., U. S. Geological Survey (Res., 3703 Thirty-fifth St., N.W.), Washington, D.C.

SPAHR, CHARLES EUGENE (Jun. '34), With Standard Oil Co. (Indiana), Sugar Creek, Mo.

SPEECE, JOHN ANTHONY (Assoc. M. '34), Chf. Asst. to Res. and Locating Engrs., State Highway Dept. (Res., 1459 Puyallup Ave.), Tacoma, Wash.

STEVENS, MALCOLM SEAVEY (Jun. '34), Box 288, Ancon, Canal Zone.

SWANSON, FRANK ELMER (Jun. '34), With State Highway Dept. (Res., North 2733 Mayfair St.), Spokane, Wash.

THELIN, CARL MILO (Assoc. M. '34), Designing Engr., City of Fort Worth (Res., 1820 Galveston St.), Fort Worth, Tex.

THOMAS, CHARLES WELDON (Jun. '34), State Highway, Rodeo, Calif.

TONEY, MARTIN (Jun. '34), 23 Jay St., Gloversville, N.Y.

TOOLE, ROLAND EMMET (Assoc. M. '34), Engr., Wisconsin Conservation Dept., State Capitol Bldg. (Res., 916 Conklin Pl.), Madison, Wis.

TWISS, FRANCIS ERNEST (Jun. '34), Asst., City Engr.'s Office (Res., 33 Keney Terrace), Hartford, Conn.

VERNON, KENNETH FRAINE (Jun. '34), With Designing Office, U. S. Bureau of Reclamation, U. S. Custom House, Denver, Colo.

VON ROSENBERG, ERNEST JACOB (Assoc. M. '34), Technical Asst., State Reclamation Dept. (Res. 702 Carolyn Ave.), Austin, Tex.

VON ROSENBERG, HERMANN URSINI (Assoc. M. '34), Technical Asst., State Reclamation Dept. (Res., 709 East 24th St.), Austin, Tex.

WAIDELICH, JAMES RICHARD (Jun. '34), 5216 North 10th St., Philadelphia, Pa.

WALKER, CHARLES RICE (Jun. '34), 1402 West Clinch Ave., Knoxville, Tenn.

WARD, PAUL ALBAN (Jun. '34), 66 Ninth Ave., Newark, N.J.

WILEY, JOHN SAFFORD (Jun. '34), 81 Perkins Hall, Harvard Univ., Cambridge, Mass.

WILSON, RUDYARD OLIVER (Jun. '34), 349 Washington St., Apartment C-5, Hartford, Conn.

WITTENBORN, EUGENE LOUIS, Jr. (Jun. '34), 1103 North Shore Ave., Chicago, Ill.

YOUNG, WILLIAM HILBOURN (Jun. '34), 5137 Catharine St., Philadelphia, Pa.

YUDA, WILLIAM ALEXANDER (Jun. '34), Center St., Pearl River, N.Y.

MEMBERSHIP TRANSFERS

BENFORD, WILLIAM RAMSDEN (Jun. '28; Assoc. M. '34), Cons. Engr.; Instr., Civ. Eng., Brown Univ., Providence, R.I.

BROWNELL, CLARENCE JOHN (Jun. '26; Assoc. M. '34), Associate Bridge Constr. Engr., San Francisco-Oakland Bay Bridge, 500 Sansome St., San Francisco, Calif.

DARLING, WILLIAM LAFAYETTE (M. '92; Hon. M. '34), Cons. Engr., 2100 Iglehart Ave., St. Paul, Minn.

DOHERTY, WILLIAM EDWARD ALOYSIUS (Assoc. M. '28; M. '34), Engr. of Constr., Bureau of Highways (Res., 1715 Porter St.), Philadelphia, Pa.

GRANT, HORACE (Jun. '29; Assoc. M. '34), Asst. Engr., Empire City Subway Co., Ltd., 138 Spring St., New York, N.Y.

GRIFFIN, ALMERN FREDERICK (Assoc. M. '24; M. '34), Senior Engr., Upper Mississippi Div., U.S. Engrs., 815 Victoria Bldg., St. Louis (Res., 640 Pearl Ave., Kirkwood), Mo.

HENDON, HARRY HOLMAN (Jun. '32; Assoc. M. '34), San. Engr., Jefferson County Eng. Dept., Room 216, Court House, Birmingham, Ala.

HOCHSTEIN, IRWIN (Jun. '32; Assoc. M. '34), Asst. Engr., Civ. Works Administration, New York (Res., 1654 East 3d St., Brooklyn), N.Y.

HOYT, CHARLES ROYDEN (Assoc. M. '24; M. '34), Structural Engr., Board of Education, Los Angeles (Res., 431 South Beloit Ave., Brentwood Heights, West Los Angeles), Calif.

KURTZ, ROBERTO (Assoc. M. '25; M. '34), Engr. and Constructor (Demartini y Kurtz), Espana 719, Campana, Argentine Republic.

LARSEN, HAROLD THEODORE (Jun. '24; Assoc M. '28; M. '34), Editor of Proceedings, Am. Soc. C.E., 33 West 39th St., Room 1607, New York, N.Y.

MARRA, JAMES VINCENT (Jun. '29; Assoc. M. '34), Senior Engr., Works Div., Dept. of Public Welfare (Res., 1279 Morris Ave.), New York, N.Y.

MICHAEL, ARTHUR CHILTON (Jun. '28; Assoc. M. '34), Field Engr. of Constr., Dept. of Water Supply, City of Detroit, 8300 West Warren Ave., Dearborn (Res., 15480 Kentucky Ave., Detroit), Mich.

OBERT, RUSSELL MELVIN (Jun. '26; Assoc. M. '34), Asst. Engr., Columbia Eng. Corporation (Res., 627 South Wayne Ave.), Columbus, Ohio.

POLLARD, LAWRENCE WELFORD (Assoc. M. '26; M. '34), Director, South Carolina Railroad Comm., Elec. Utilities Div., Columbia, S.C.

RICH, GEORGE ROLLO (Jun. '21; Assoc. M. '27; M. '34), Hydr. Engr., U.S. Engr. Office, 707 Postal Telegraph Bldg., Kansas City, Mo.

ROSBERG, EDWARD OSCAR (Jun. '30; Assoc. M. '34), Estimator and Asst. Engr., Herrick Iron Works, 18th and Campbell Sts., Oakland (Res., 1558 Waller St., San Francisco), Calif.

SENSING, WILBUR CARSON (Jun. '26; Assoc. M. '34), Engr. and Secy., Wilson-Weesner-Wilkinson Co., 108 Fatherland St., Nashville, Tenn.

WARD, RONALD DAVIES (Jun. '26; Assoc. M. '34), Engr., Operating Dept., Shell Petroleum Corporation, Shell Bldg., St. Louis (Res., 111 West Cedar Ave., Webster Groves), Mo.

WOOD, LEWIS KEYSER (Jun. '27; Assoc. M. '34), Asst. and Associate Bridge Const. Engr., San Francisco–Oakland Bay Bridge, 500 Sansome St., San Francisco (Res., 1105 Ordway St., Berkeley), Calif.

RESIGNATIONS

BRISEL, NORMAN JACOB, Assoc. M., resigned Nov. 22, 1934.

BOLTER, WARD HENES, Jun., resigned Nov. 14, 1934.

EBY, MARTIN KELLER, Jun., resigned Nov. 22, 1934.

HEWSON, REGINALD JOSEPH BEDFORD, M., resigned Nov. 10, 1934.

PIERCE, ROBERT GORDON, Jun., resigned Nov. 14, 1934.

RASMUSSEN, LAURITZ HERMANN, Jun., resigned Nov. 15, 1934.

SAMMARCO, SERGIO FRANCIS, Assoc. M., resigned Dec. 4, 1934.

SMITH, CLYDE C., Assoc. M., resigned Nov. 13, 1934.

BARKER, CHARLES WHITNEY TILLINGHAST, Assoc. M., resigned Dec. 3, 1934.

WEBB, ISHAM GANO, Assoc. M., resigned Nov. 12, 1934.

DEATHS

HATCH, FREDERICK NATHANIEL. Elected Jun., June 4, 1907; Assoc. M., Feb. 4, 1913; M., April 26, 1921; died Nov. 13, 1934.

HEWITT, CHARLES EDWARD. Elected M., Oct. 5, 1887; died Aug. 8, 1933.

KIERSTED, WYNKOOP. Elected M., Oct. 5, 1887; died Nov. 7, 1924.

KORNFELD, HARRY. Elected Jun., Sept. 3, 1912; Assoc. M., Oct. 9, 1917; died Nov. 8, 1934.

KRIEGSHABER, VICTOR HUGO. Elected M., April 2, 1913; died Nov. 10, 1934.

PRICHARD, HENRY SEWALL. Elected M., Jan. 2, 1895; M., Oct. 17, 1934.

SHUROT, PAUL ALBERT NICOLAS. Elected Jun.; April 30, 1895; Assoc. M., Oct. 4, 1899; M., Nov. 1, 1904; died Nov. 18, 1934.

WHITENER, JOHN SUMMIE. Elected Assoc. M., Mar. 11, 1929; died Oct. 10, 1934.

WILSON, HERBERT ALVA. Elected M., Oct. 1, 1912; died May 7, 1934.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

January 1, 1935 NUMBER 1

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years†	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

FOR ADMISSION

ADDICOTT, LEWIS JAMES, Athens, Ohio. (Age 66.) Head of Dept. of Civ. Eng. and Superv. Archt., Ohio Univ. Refers to R. L. Harding, F. H. Neff, F. L. Plummer, G. A. Reese, C. E. Sherman, M. W. Watson.

ANTHONY, JAMES ARISTOTLE, New York City. (Age 30.) Refers to C. T. Schwarze, D. S. Trowbridge.

BABB, WILLARD ARTHUR, Kansas City, Mo. (Age 27.) Draftsman, U.S. Engr. Office. Refers to J. O. Jones, W. C. McNown, F. A. Russell, L. R. Young.

BLASCHKE, THEODORE OSCAR, North Platte, Nebr. (Age 30.) Designer with Platte Valley Public Power & Irrigation Dist. Refers to W. Grant, P. F. Keim, H. J. Kesner, J. G. Mason, A. L. Ogle, J. I. Quinn.

BONDURANT, JOHN PARNELL, Athens, Ga. (Age 27). Senior Project Asst., National Park Service, Gainesville, Ga. Refers to J. G. Beacham, R. S. Fiske, R. V. Glenn, E. S. Humphreys, C. M. Strahan.

BRUMMETT, R. C., Carlsbad, N.Mex. (Age 27.) Instrumentman, U. S. Reclamation Service, ECWW with CCC on Carlsbad Irrigation Project. Refers to O. V. Adams, G. R. Johnston, J. H. Murdough, G. W. Parkhill, H. N. Roberts.

BUTKIEWICZ, JOSEPH WALLACE, New York City. (Age 25.) Refers to A. E. Hilliard, C. G. Hoerner, Jr., C. T. Schwarze, D. S. Trowbridge.

CARDWELL, JOHN WESLEY, Jackson Heights, N.Y. (Age 43.) Engr., U.S. Govt., Dept. of Interior, PWA work. Refers to H. C. Baird.

F. S. Childs, W. F. Dennis, C. W. Lovell, A. J. Sackett.

CLARK, CHARLES OTIS, Madison, Wis. (Age 21.) Refers to F. M. Dawson, H. F. Janda, D. W. Mead, F. E. Turneaure, L. F. Van Hagan.

CLARKE, GILMORE DAVID, Pelham, N.Y. (Age 42.) Landscape Archt., Westchester County Park Comm., White Plains, N.Y. Refers to E. Anderberg, J. Downer, A. G. Hayden, L. G. Holleran, E. Praeger, W. J. Wilgus.

COCHRAN, DONALD STURGEON, Baltimore, Md. (Age 27.) Refers to A. Diefendorf, L. C. McCandliss, J. M. Rayburn.

DREW, SAMUEL TILTON, Braintree, Mass. (Age 36.) Project Engr., Metcalf & Eddy Boston, Mass. Refers to E. S. Chase, H. P. Eddy, F. A. Marston, A. L. Shaw, C. W. Sherman.

ELDRIDGE, CLARK HENRY, Seattle, Wash. (Age 38.) Engr. with City of Seattle, Wash. Refers to H. M. Hadley, D. W. McMorris, C. C. More, O. A. Piper, M. O. Sylliaasen, W. F. Way, J. R. West.

EMBURY, AYMAR, II, New York City. (Age 54.) Archt. Refers to O. H. Ammann, F. H. Constant, A. Dana, R. Smillie, D. B. Steinman. (Readmission)

ETKES, PEREZ WILLARD, Haifa, Palestine. (Age 42.) Engr.-in-Chg., Haifa Dist., Dept. of Public Works, Palestine Govt. Refers to F. E. Foss, L. S. Moisseiff, A. I. Raisman, R. Ridgway, F. E. Schmitt.

FARNSWORTH, GEORGE ELMER, Los Angeles, Cal. (Age 51.) Associate Highway Constr. Engr. and Res. Engr., California Div. of Highways. Refers to H. P. Cortelyou, S. V. Cortelyou, A. N. George, I. O. Jahlstrom, R. A. Klein, H. Nunn, C. J. Shults.

GAY, HOWARD SPOONER, Washington, D.C. (Age 52.) Engr. Examiner and Executive Secy., Technical Board of Review, PWA. Refers to L. J. Bevan, F. O. Blackwell, E. W. Crawley, F. O. Dufour, W. W. Horner. (Readmission)

GREENBLATH, ABRAHAM MYRON, St. Albans, N.Y. (Age 38.) Refers to L. L. Balleisen, H. C. Dinney, S. C. Gordon, J. H. Myers, A. E. Roche, J. J. Weinrib.

GRIMES, BENJAMIN LYMAN, JR., El Paso, Tex. (Age 27.) San. Engr., City-County Health Dept. Refers to J. C. Bisset, A. H. Dunlap, A. M. Erskine, W. J. Miles, H. E. Miller, H. N. Old.

GRUSS, JOHN GODFREY, Philadelphia, Pa. (Age 40.) Asst. Engr., Albright & Friel, Inc., Engrs., on water supply, sewers, sewage-disposal plants, etc. Refers to H. M. Freeburn, F. S. Friel, J. D. Justin, G. B. Rumble, S. I. Sacks.

HAMLIN, ERNEST JOHN, Johannesburg, S. Africa. (Age 47.) City Engr., Johannesburg. Refers to F. G. Cunningham, G. M. Fair, G. B. Gascoigne, R. H. Gould, S. A. Greeley, G. B. de B. Kershaw, L. Pearse.

HANSEN, ARTHUR CHESTER, JR., Mineola, N.Y. (Age 22.) Refers to H. P. Hammond, L. F. Rader, E. J. Squire.

HEPBURN, DONALD OLIVER, Flushing, N.Y. (Age 34.) Asst. Engr., CWA and WDD-PW. Refers to R. F. Conklin, H. S. Holt, A. E. Howland, C. U. Powell, R. C. Springer, A. U. Whitson.

HILL, LELAND KERR, Ogden, Utah. (Age 28.) Jun. Civ. Engr. with U.S. Forest Service. Refers to O. W. Israelsen, R. B. West.

HINDS, CHESTER MACON, Arlington, Mass. (Age 40.) Dist. Engr., Kalman Steel Corporation, Boston, Mass. Refers to A. E. Bump, A. P. Clark, M. W. Lautz, N. Stone, W. S. Thomson, E. F. Tomlinson, E. A. Tucker.

HOUSH, HARRY M., Oklahoma City, Okla. (Age 41.) Asst. State Engr., FERA. Refers to L. M. Bush, J. E. Kirkham, R. V. Lindsey, V. V. Long, B. S. Myers, M. J. Reinhart, C. H. Rightmire.

JOHNSON, JOE WILLIAM, Vicksburg, Miss. (Age 26.) Gauge Reader, U. S. Waterways Experiment Station. Refers to B. A. Etcheverry, S. T. Harding, M. P. O'Brien.

JONES, LEWIS HENRY, JR., Corpus Christi, Tex. (Age 22.) Instrumentman, Texas State Highway Dept. Refers to M. Johnson, J. T. L. McNew.

KENNEY, HARVEY ALEXANDER, Pierson, Mich. (Age 27.) Contr. Refers to C. L. Allen, C. M. Cade.

LABATE, ANTHONY PETER, Petersburg, Pa. (Age 25.) Engr., Forestry Service. Refers to L. Perry, E. H. Rockwell.

LAZENBY, ARTHUR J., Salt Lake City, Utah. (Age 26.) Asst. San. Engr., Salt Lake City. Refers to T. C. Adams, R. B. Ketchum, G. H. Taylor.

LEPP, JOHN, Brooklyn, N.Y. (Age 26.) Refers to D. Derickson, W. B. Gregory.

LINDQUIST, ALBERT KENNETH, Troy, N.Y. (Age 28.) Rodman, U. S. Geological Survey. Refers to L. W. Clark, E. S. Jarrett, W. W. Rousseau, H. O. Sharp, W. F. Shaw, G. R. Solomon.

MANES, COLE, Dallas, Tex. (Age 34.) City Engr., University Park, Tex. Refers to E. C. H. Bantel, H. W. English, W. H. Meier, E. N. Noyes, W. J. Powell.

MITCHELL, STERLING ROSS, El Paso, Tex. (Age 35.) Asst. Div. Engr., Texas State Highway Dept. Refers to G. G. Edwards, H. R. P. Helland, C. S. Henning, Jr., R. E. Killmer, J. G. Lott, J. Montgomery, J. E. Ward.

MOFFETT, ROBERT NELSON, Pottsville, Pa. (Age 22.) Draftsman, Philadelphia & Reading Coal & Iron Co. Refers to M. O. Fuller, H. G. Payrow.

MONACO, ANGELO MICHAEL, Brooklyn, N.Y. (Age 24.) Refers to C. T. Schwarze, D. S. Trowbridge.

MONTAGUE, GEORGE ALFRED, Worcester, Mass. (Age 50.) Superv. Engr., Massachusetts Dept. of Public Works (Highway Div.). Refers to W. E. Corbett, A. W. Dean, J. N. Ferguson, J. A. Johnston, C. U. Stepath, A. D. Weston.

MUNOZ, CARLOS ALBERTO, Rio Piedras, Puerto Rico. (Age 26.) Inspector, U. S. Engr. Office, Puerto Rico Dist. Refers to F. Fortuno-Selles, J. D. Morales, S. Quinones, R. Ramirez, R. Skerrett-Landron, E. Totti y Torres.

NEAL, RUSSELL BIERER, Philadelphia, Pa. (Age 21.) Refers to O. W. J. Anschuetz, A. L. Hyde, E. J. McCaustland, C. A. Neal, H. K. Rubey.

PEDIGO, RUSSELL HAYMAKER, West Memphis, Ark. (Age 33.) Res. Engr., St. Francis Levee Dist. Refers to J. C. Carpenter, T. T. Knappen, W. W. McClevy, W. A. K. Parkin, B. A. Ross.

RICH, CHARLES CARLYLE, Brigham City, Utah. (Age 22.) Engr., E. R. A. Land Utilization Project, Salt Lake County, Utah. Refers to G. D. Clyde, O. W. Israelsen, H. R. Kepner, R. B. West, L. M. Winsor.

RILEY, EDWARD CHAMPLAIN, Plainfield, N.J. (Age 25.) Field Engr., Massachusetts State Dept. of Public Health, Boston, Mass. Refers to W. J. Douglas, S. M. Ellsworth.

SASTRE, MIGUEL ANGEL, Ponce, Puerto Rico. (Age 27.) With Sucesion J. Serralles. Refers to J. M. Canals, H. P. Conesa, J. M. Giles, A. Nones, D. S. Trowbridge.

SCHOELLER, CHARLES PHILIP, Los Angeles, Cal. (Age 25.) Refers to R. R. Martel, W. W. Michael, F. Thomas.

SHARP, JAMES FRANCIS, Chattanooga, Tenn. (Age 22.) With T.V.A., Aerial Mapping Div. Refers to W. A. Coolidge, F. J. Lewis.

SHAW, RALPH, Chicago, Ill. (Age 41.) Designer (Hydr. and Concrete), Loup River Public Power Dist., Columbus, Nebr. Refers to J. S. Bowman, F. A. Dale, L. F. Harza, C. H. James, D. W. Mead, R. L. Paulus, C. N. Ward.

STANKEWICH, MICHAEL JOSEPH, South Ozone Park, N.Y. (Age 27.) Graduate Student, New York Univ. Refers to W. H. Kershaw, T. Saville, C. T. Schwarze, D. S. Trowbridge.

THOMAS, FRANCIS, Leonia, N.J. (Age 28.) Party Chf., Park Dept., New York City. Refers to E. J. Carrillo, P. D. G. Hamilton, L. Hussey, E. D. Johnstone, C. S. Joslyn, J. Wilmot.

UBBINK, WILLIAM JOHN, Port Washington, Wis. (Age 44.) County Highway Commr., Ozaukee County, Wis. Refers to B. E. Brevik, W. F. Cavanaugh, J. L. Ferebee, R. C. Johnson, H. J. Kuelling, W. H. Lange, H. Y. Smith.

WANKMULLER, JACOB WILLIAM THOMAS, Glendale, N.Y. (Age 24.) Refers to C. T. Schwarze, D. S. Trowbridge.

WEBSTER, HENRY MORISON, Knoxville, Tenn. (Age 30.) Engr., Tennessee Valley Authority, Norris, Tenn. Refers to J. G. Allen, J. A. Anderson, B. M. Jones, G. E. Tomlinson, I. L. Tyler, W. D. Tyler.

WILLIAMS, BYRD MOORE, JR., Ft. Worth, Tex. (Age 51.) Constr. Engr., City of Ft. Worth. Refers to O. E. Carr, J. C. Feild, J. N. Gladding, W. O. Jones, D. L. Lewis, D. C. Lipscomb, M. C. Nichols, G. F. Nicholson, H. Nunn, T. U. Taylor, F. H. Todd.

WILLIAMSON, JOE, St. Louis, Mo. (Age 28.) Chf. Draftsman, Russell & Axon, Cons. Engrs., Inc. Refers to F. Bachmann, A. F. Barnes, J. B. Butler, C. V. Mann, J. C. Pritchard, G. S. Russell, L. M. Shumaker.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

FROST, LLOYD GARNER, Assoc. M., Lake Providence, La. (Elected May 19, 1924.) (Age 40.) Parish Engr., FERA. East and West Carroll Parishes. Refers to F. N. Billingsley, A. M. Blodgett, C. G. Cappel, J. B. Converse, M. Goodkind, G. A. Graham, I. G. Hedrick, O. Laurgaard, J. P. Newell, C. E. Payne, W. H. Williams.

HODGES, RICHARD MCKANDLISH, Assoc. M., Long Island City, N.Y. (Elected Feb. 25, 1924.) (Age 47.) Asst. Engr. (Structural Design), Design Div., Eng. Dept., Westchester County Park Comm., Bronxville and White Plains, N.Y. Refers to E. Anderberg, J. Barnett, J. Downer, C. A. Garfield, A. G. Hayden, L. G. Holleran, N. D. Richardson.

LIVINGSTON, PENN POORE, Assoc. M., Washington, D.C. (Elected Oct. 10, 1927.) (Age 35.) Assoc. Engr., Div. of Ground Water, U. S. Geological Survey. Refers to C. T. Bartlett, C. S. Clark, N. C. Grover, J. M. Nagle, J. A. Norris, F. E. Turneaure.

MCCURDY, HORACE WINSLOW, Assoc. M., Seattle, Wash. (Elected March 15, 1926.) (Age 35.) Pres. and Gen. Mgr., Puget Sound Bridge & Dredging Co. Refers to S. H. Hedges, J. Jacobs, J. B. C. Lockwood, D. W. McMorris, W. C. Morse, R. G. Tyler.

MYERS, CLYDE, Assoc. M., Phoenix, Ariz. (Elected April 19, 1920.) (Age 50.) Prof. of Civ. Eng. and Director of Eng., Phoenix Junior Coll. Refers to A. D. Butler, C. E. Davis, J. B. Girand, R. A. Hoffman, E. V. Miller, M. K. Snyder.

PROCTOR, RALPH ROSCOE, Assoc. M., Glendale Cal. (Elected July 11, 1927.) (Age 40.) Field Engr., Bureau of Water-Works and Supply, Dept. of Water and Power, Los Angeles, Cal. Refers to E. A. Bayley, T. Brooks, J. Hinds, W. W. Hurlbut, J. B. Lippincott, J. E. Phillips, H. A. Van Norman, F. E. Weymouth.

REESE, GEORGE ADAM, Assoc. M., Canton, Ohio. (Elected Nov. 14, 1927.) (Age 43.) Cons. Engr. Refers to W. H. Dittoe, E. J. Landor, F. D. Stewart, F. E. Swineford, F. H. Waring, E. A. Zeisloft.

WILMOT, JAMES, Assoc. M., Port Chester, N.Y. (Elected Junior Sept. 1, 1908; Assoc. M. Nov. 28, 1916). (Age 50.) Borough Engr., Park Dept., New York City. Refers to H. J. Alexander, J. P. Carlin, G. H. Davis, A. P. Hoover, R. Ridgway, C. J. Sheridan, F. J. Trelease, F. C. Zeigler.

WISLER, CHESTER OWEN, Assoc. M., Ann Arbor, Mich. (Elected April 14, 1919.) (Age 53.) Prof. of Hydr. Eng., Univ. of Michigan. Refers to L. M. Gram, A. J. Hammond, R. E. Horton, H. W. King, H. E. Riggs.

FROM THE GRADE OF JUNIOR

ANDERSON, GEORGE RANDOLPH, Jun., Topeka, Kans. (Elected March 15, 1926.) (Age 32.) Jun. Designer, Design Dept., Kansas Highway Comm. Refers to H. D. Barnes, T. E. Burton, W. K. Dinklage, O. J. Eidmann, L. Grover, R. C. Keeling, C. C. Martin.

ARENANDER, CARL ALFRED, Jun., Newark, N.J. (Elected Feb. 10, 1930.) (Age 28.) Asst. Engr. with Malcolm Pirnie, New York City. Refers to F. A. Barbour, G. M. Fair, W. E. Fuller, A. Haertlein, S. B. Lilly, M. Pirnie, F. H. Weed.

BINKLEY, THAD CHRISTIAN, Jun., Palo Alto, Cal. (Elected Oct. 10, 1927.) (Age 33.) Supt., Suburban Water Co., San Francisco, Cal. Refers to R. F. Brown, H. A. Harris, Jr., M. J. Hvorslev, L. B. Reynolds, H. Schorer, F. M. Thebo.

BOLIEAU, CLIFTON WILLIAMS, Jun., New York City. (Elected Jan. 13, 1930.) (Age 32.) Asst. Engr. with Malcolm Pirnie, New York City. Refers to L. M. Fisher, R. V. Giles, K. K. King, A. P. Miller, M. Pirnie, C. F. Ruff, P. S. Wilson.

BURKE, EDWARD JOHN, Jun., Valley Stream, N.Y. (Elected Dec. 14, 1925.) (Age 32.) Draftsman, Pennsylvania R.R. Co. Refers to H. G. Altvater, F. Auryansen, F. S. Borden, F. L. Castleman, P. Penhune, R. L. Schoppe.

COMBS, THEODORE CARLOS, Jun., Long Beach, Cal. (Elected Oct. 14, 1930.) (Age 28.) Field Engr., National Lumber Mfrs.' Assoc. and Timber Eng. Co., Washington, D.C. Refers to F. J. Converse, A. C. Horner, J. E. Mackie, R. G. Manley, R. R. Martel, D. H. Merrill, H. F. Peterson, M. C. Poulsen, F. Thomas.

CRANDELL, OLIN HICKS, Jun., Dallas, Tex. (Elected Feb. 25, 1924.) (Age 32.) Engr., Magnolia Petroleum Co. Refers to F. N. Baldwin, J. D. Fowler, D. C. Howard, J. H. Knox, R. B. Pearce, J. W. Porter, W. J. Powell, H. L. Thackwell.

DEWITT, JOHN ELLINGWOOD, Jun., Scarsdale, N.Y. (Elected Oct. 14, 1929.) Appraisal Engineer, Hine, Goldthwaite & Mylott, New York City. Refers to C. B. Benson, N. P. Gerhard, C. A. Lass, A. Lau, A. H. Pratt, W. R. Wolff.

EVANS, SOMERBY ROGERS, Jun., Petersburg, Va. (Elected Oct. 1, 1926.) (Age 32.) Asst. Engr., Production Dept., Atmospheric Nitrogen Corporation, Hopewell, Va. Refers to L. V. Branch, W. R. McCann, T. C. Morris, W. Rowland, W. G. B. Thompson.

HERTENSTEIN, WESLEY, Jun., Pasadena, Cal. (Elected Oct. 1, 1926.) (Age 33.) Constr. Engr., California Inst. of Technology. Refers to R. R. Martel, W. W. Michael, T. R. Mini, S. B. Morris, R. B. Ray, C. W. Sopp, F. Thomas.

LAIDLAW, DOUGLAS STAUNTON, Jun., Toronto, Ont., Canada. (Elected April 25, 1932.) (Age 29.) Structural Engr. in partnership with Catto & Catto, Archts. Refers to O. B. Bestor, A. H. Harkness, T. H. Hogg, C. H. Mitchell, J. R. Montague, C. R. Young.

LUNDY, THOMAS EMMETT, Jun., Longview, Tex. (Elected Oct. 14, 1929.) (Age 31.) Asst. Engr. for H. L. Thackwell, Cons. Engr., Tyler, Tex. Refers to T. L. Bell, Jr., G. A. Bracher, F. L. Bramlette, J. S. DeRemer, C. S. Lambie, A. O. Ridgway, H. L. Thackwell.

MCGEE, HENDERSON ENGLAND, Jun., Stockton, Cal. (Elected June 4, 1928.) (Age 30.) Jun. Engr., U.S. Engr. Office, Sacramento Dist.; 1st Asst. to Engr.-in-Chg., Stockton Ship Channel Project. Refers to R. L. Egenhoff, C. A. J. English, P. S. Jones, L. P. Raynor H. M. Rich, O. G. Stanley, C. M. Weber.

ROCHE, EDWARD CHARLES, Jun., Kenmore, N.Y. (Elected Oct. 14, 1930.) (Age 33.) Engr., Research Laboratories, Linde Air Products Co. Buffalo, N.Y. Refers to J. B. Babcock, 3d, C. B. Breed, T. R. Camp, W. M. Fife, J. W. Howard, G. E. Russell, C. M. Spofford.

SAWYER, ROBERT WILLIAM, JR., Jun., New York City. (Elected Oct. 20, 1931.) (Age 28.) Asst. Engr. with Malcolm Pirnie. Refers to R. K. Blanchard, G. M. Fair, A. Haertlein, H. S. Morse, M. Pirnie, E. W. Whitlock.

SCHMIDT, ROBERT ALAN, Jun., Flushing, N.Y. (Elected Jan. 16, 1928.) (Age 29.) Asst. Engr., New York and Queens Elec. Light and Power Co. Refers to T. J. Carlile, R. E. Goodwin, H. Holbrook, B. Kipp, J. A. Lenecek, W. A. Melny, C. B. Molineaux, W. H. Walker.

SOGA, SUSUMU, Jun., Tokyo, Japan. (Elected Nov. 12, 1928.) (Age 32.) Engr. with Okura Doboku Kabushiki Kaishia. Refers to M. Abe, H. Cross, S. Hardesty, W. C. Huntington, F. E. Richart, W. M. Wilson.

TALLAMY, BERTRAM DALLBY, Jun., Williamsville, N.Y. (Elected March 30, 1931). (Age 33.) Fretts, Tallamy & Senior, Cons. Engrs. Refers to C. H. Field, S. S. Neff, P. C. Ricketts, F. H. Robinson, E. H. Sargent.

THATCHER, JOHN ROBERT, Jun., Fort Peck, Mont. (Elected Oct. 1, 1928.) (Age 32.) Associate Engr., Fort Peck Engr. Dist., U. S. Engrs. Refers to J. R. Coltharp, P. E. Cunningham, T. B. Larkin, E. G. Plank, L. F. Reynolds.

THOMAS, FRANCIS JOHN, Jun., Denver, Colo. (Elected Dec. 5, 1927.) (Age 32.) Jun. Engr., U. S. Bureau of Reclamation. Refers to J. J. Hammond, J. L. Savage, R. A. See, B. W. Steele, H. W. Tabor.

WACHTER, FRANK CLEMENT, Jun., Baltimore, Md. (Elected Feb. 24, 1931.) (Age 31.) Office Engr. with Henry G. Perring Co., Archts. and Engrs. Refers to T. F. Comber, Jr., T. F. Hubbard, C. E. Keefer, F. W. Medaugh, H. G. Perring, J. T. Thompson.

WALLACE, JOHN HERBERT, JR., Jun., Los Angeles, Cal. (Elected July 12, 1926.) (Age 32.) Constr. Supt. with City of Los Angeles, Cal., being Gen. Supt. on Jefferson St. Storm Drain. Refers to L. Aldrich, P. L. Hazard, J. C. Lindsay, R. J. Reed, L. B. Reynolds, J. H. Wallace, W. E. Whittier, C. B. Wing.

WHITE, CLARK LEO, Jun., Bethlehem, Pa. (Elected July 12, 1926.) (Age 32.) Engr. Bethlehem Steel Co. and McClintic Marshall Corporation. Refers to E. F. Ball, E. L. Durkee, D. S. Gendell, Jr., H. O. Hill, M. G. Hilpert, J. Jones, R. W. Knight, L. C. McCandliss, J. A. Nelson, G. E. Poucher.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 85 of the 1934 Year Book of the Society. To expedite publication, notices should be sent direct to the employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when the reply should be sent to the office designated.

CONSTRUCTION

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; age 39; married; B.S. in C.E., Massachusetts Institute of Technology; New York State Professional Engineers License; 9 years experience surveying; design and construction. Sewers, sewage disposal plants, subways, and charge of erection of advertising signs. Available immediately. B-3347.

EXECUTIVE

CONSTRUCTION ENGINEER-MANAGER; Assoc. M. Am. Soc. C.E.; 35; graduate civil engineer; 10 years construction and building experience; 7 years in South America; all grades to, and including, branch manager. Experience covers preparation of bids, estimating, engineering design, superintendence, and management. Best of records; location immaterial. D-3525.

EXECUTIVE; Assoc. M. Am. Soc. C.E.; state license; over 20 years experience, field and design. All types of buildings, specializing in theaters, studios, laboratories, government buildings. Thoroughly familiar all mechanical and refrigeration work. Desires responsible position with architect or engineer, field or office. Excellent connections, real estate and banking institutions. D-3528.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; B.S.; desires connection with contractor or manufacturer; age 45; single; American; 6 years experience in the design of reinforced concrete bridges; 7 years experience with general contractor, field and office. Experience covers estimating, plant layout, detailing, line and grade, supervision, triangulation surveying, etc. D-3283.

ENGINEER; M. Am. Soc. C.E.; desires position; accustomed to contacting people in financial, professional, and political positions and in all walks of life, selling ideas and service. Experienced in civil engineering projects; administration, supervision, inspection, promotion. Application of aerial surveys; assembly of properties; purchase of rights-of-way. D-3539.

DRAFTSMAN; Assoc. M. Am. Soc. C.E.; computer and surveyor in real estate development—design, plan, and construction of the necessary municipal improvements—roads, water, gas, electric installations, sewer and subway construction. Grade separations—railroad and highway—preliminary surveys, general planning, estimating and construction of bridges; married; 44 years of age. Licensed professional engineer in New York. D-2092.

CONCRETE SPECIALISTS; Assoc. M. Am. Soc. C.E.; 32; 10 years experience; capable of organizing and supervising concrete inspection and concrete testing laboratory on large projects. Experience on special investigation and reports on concrete and the behavior of its constituents. Several papers and discussions published in technical periodicals. Excellent references. C-8022.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; long experience as draftsman, chief of survey party, and engineer in land surveying and topography and in drainage, flood control, water supply, sewerage, and railroad engineering. Has passed U.S. Civil Service examination. Prefers vicinity of Washington, D.C., but would consider another locality. A-5125.

STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; 40; single; graduate of Massachusetts Institute of Technology; 12 years experience in detailing, designing, estimating, and erecting structural steel and reinforced concrete for mill buildings, airplane hangars, office buildings, hospitals, apartments, bins, towers, and railway bridges. Location secondary; available on short notice. D-3344.

ENGINEER EXECUTIVE; M. Am. Soc. C.E.; licensed in Pennsylvania; 47; married. Connected with steel fabricating and general construction-engineering operating and sales for over 25 years. Very successful past record. Available immediately. C-5095.

ARCHITECTURAL ENGINEER; M. Am. Soc. C.E.; M.A.I.A.; bachelor, architectural engineering; master of arts, business administration; 20 years experience in general structural and architectural practice, including 6 years of teaching mechanics, theory, and design of structures, concrete, and economics of architecture in large university. Desires teaching work along these lines. B-6345.

JUNIOR

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; single; graduate of Rensselaer Polytechnic Insti-

tute, 1934, with C.E. degree; 3 months experience in steel tube mill doing general work. Desires experience and opportunity in any branch of civil engineering. Salary and location immaterial; available immediately. D-3374.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 27; single; B.S. in C.E., Princeton University. Can speak Italian fluently; 1½ years as assistant to construction superintendent on construction of water mains in New York City; 1 year as computer, U. S. Coast and Geodetic Survey. Expert surveyor, neat draftsman. Interested in construction, hydraulics, surveying, teaching. D-3503.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 24; single; B.S. in C.E., Cooper Union Institute of Technology, 1932; postgraduate fellowship in structural engineering at the Catholic University, 1932–1933; knowledge of typing; 1 year as salesman of office equipment; 1¼ years topographical draftsman, U. S. Coast and Geodetic Survey, engaged in varied phases of aerial photomapping. C-9182.

CIVIL ENGINEER; 26; single; C.E. degree, Rensselaer Polytechnic Institute; 1 year drafting and 1 year business experience. Desires position in any branch of civil engineering. Available now. Location immaterial. D-1113.

RECENT GRADUATE, POLYTECHNIC INSTITUTE OF BROOKLYN; Jun. Am. Soc. C.E.; Tau Beta Pi member. Advanced study in highway and structural engineering. Desires position in any field of civil engineering, mainly for experience. Not afraid of hard labor. Location immaterial. D-3529.

GRADUATE CIVIL ENGINEER, Jun. Am. Soc. C.E.; B.S. and C.E.; 1 year of postgraduate work in structures and hydraulics; 1 year experience in surveying and topographical drafting; native born; 25 years of age. Speaks Russian, Polish, and German. Will go any place in the United States or foreign country. Ready immediately. D-3540.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; single; B.S. in C.E., University of Washington, 1933. Majored in structural design; 4 months rodman-chainman; 4 months; painting inspector; neat and accurate draftsman. Desires opportunity in any branch of civil engineering. Available immediately. Location immaterial. D-3554.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 26; single; B.S. in C.E., Duke University, 1933. Majored in structural steel design and water supply; 1 month with U. S. Coast and Geodetic Survey; 3 months experience, water and sewage works; 3 years as inspector of telephone apparatus. Desires opportunity in any branch of civil engineering. Location immaterial. Available immediately. D-2683.

JUNIOR CIVIL ENGINEER; Jun. Am. Soc. C.E.; 4 years experience as transitman on maps, computations on highway, waterway, and underground projects. Record includes New York Central and U. S. Gypsum Company assignments. Qualified for junior engineer in U. S. Coast and Geodetic Survey. Single; citizen; age 30; able-bodied; good eyesight. Will go anywhere except tropic lowlands. C-6530.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; B.S. in architectural engineering, Massachusetts Institute of Technology, 1932; age 23; single; 1 year general engineering experience in structural steel and reinforced concrete design; 7 months as assistant engineer with CWA in survey work; field or office; desires experience; salary secondary. D-3285.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 24; single; B.S. in C.E., Rhode Island State College, 1932; 3 months experience in U. S. Coast and Geodetic Surveying; some experience in architectural design and construction; neat and accurate draftsman. Desires opportunity in any branch of civil engineering; would prefer building design and construction. Location immaterial. D-3335.

GRADUATE ENGINEER; Jun. Am. Soc. C.E.; 23; B.C.E., Polytechnic Institute of Brooklyn, 1933; 1 year additional study as graduate fellow; majored in advanced structures and engineering economics. Will take temporary or permanent work in field or office. Some experience on railroad construction projects. Opportunity for active and ambitious person desired. D-2990.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 22; single; B.S. in C.E., Newark College of Engineering; 1 year as assistant in civil engineering office; 1 year as physics instructor; 6 months as supervisor of motor vehicle traffic survey. Desires opportunity in any branch of civil engineering; location secondary. D-2960.

SALES

SALES ENGINEER; M. Am. Soc. C.E.; wants position in the Middle West, preferably Chicago district; 11 years broad experience in municipal engineering, sewer and water-works construction; for past 10 years in charge of sales for large company manufacturing sewer and water pressure pipe. Best of references as to ability and character. D-3507.

TEACHING

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 30; single; B.S. in civil engineering, Pennsylvania State College; majored in city planning and highway engineering; 9 years experience, general construction; experienced instructor, author, public speaker, and executive; desires position as instructor, research or executive in civil engineering. D-2776.

STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; state license; B.S. in C.E. and C.E. degrees; 30; 1 year on bridge construction; 5 years on bridge and building design in charge of important work; now in fourth year teaching as assistant professor of civil engineering. Desires responsible teaching or commercial position with established firm. Available on one month's notice. D-3557.

RECENT BOOKS

New books of interest to Civil Engineers, donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 75 of the Year Book for 1934. These notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

ABWASSERFACHGRUPPE DER DEUTSCHEN GESELLSCHAFT FÜR BAUWESEN. Schriftenreihe, Heft 2. ABWASSERPUMPWERKE und DRUCKROHRE. Munich and Berlin, R. Oldenbourg, 1934. 170 pp., diagrs., charts, 12 × 8 in., paper, 2.50 rm.

This pamphlet presents general instructions for the construction of sewage pumping plants and discharge pipes, and is intended to guide mechanical engineers and sewage engineers. The regulations are the work of the sewage section of the Deutsche Gesellschaft fuer Bauwesen, in collaboration with leading German machine builders.

DIE ARÄOMETER-METHODE ZUR BESTIMMUNG DER KORNVERTEILUNG VON BÖDEN UND ANDEREN MATERIALIEN. By A. Casagrande. Berlin, J. Springer, 1934. 56 pp., illus., diagrs., charts, tables, 10 × 6 in., paper, 4.50 rm.

A translation of a report that Dr. Casagrande submitted to the U. S. Bureau of Public Roads in 1931, upon his investigations of the use of the hydrometer for the mechanical analysis of soils. The theory of the method, possible sources of error, and their influence on results are discussed, and the analytical procedure is described.

EIDGENÖSSISCHE MATERIALPRÜFUNGSANSTALT AN DER E.T.H. IN ZÜRICH. (Laboratoire Fédéral d'Essai des Matériaux Annéxé à l'École Polytechnique Fedérale à Zurich). BERICHT No. 63, June 1933, 42 pp. Untersuchungen über die Bestimmung des freien Kalkes und des Kalziumhydroxydes in Zementklinkern, Zementen, Schlacken und abgebundenen hydraulischen Mörteln. By P. Schläpfer and R. Bukowski. BERICHT No. 67, July 1933, 64 pp. Untersuchungen über die Eigenschaften des Mono-, Di- und Trikalziumsilikates und des Mono-, Pentatri- und Trikalziumaluminates. By P. Schläpfer and G. Berger. illus., diagrs., charts, tables, 12 × 8 in., paper, apply.

These two reports from the Swiss Laboratory for Testing Materials form parts of an investigation of the constitution and behavior of portland cement. One report examines critically various methods for the quantitative determination of free lime and calcium hydroxide in cement clinker and ground cement. The second is a study of the properties of certain silicates and aluminates of calcium, with special reference to the setting of portland cement.

FIRE INSURANCE CLASSIFICATION OF CITIES AND FIRE LOSSES. (Public Administration Service No 43.) By H. A. Stone. Chicago, Public Administration Service, 1934. 25 pp., charts, tables, 11 × 8 in., paper 50 cents.

This pamphlet presents data concerning fire losses in 43 American cities and correlates these with the classification set by the National Board of Fire Underwriters. The author concludes that no relationship exists between this classification and the losses and number of fires, and that a better grading schedule is needed.

HYDRAULICS OF FLOOD MOVEMENTS IN RIVERS. By H. A. Thomas. Pittsburgh, Carnegie Institute of Technology, 1934. 70 pp., diagrs., charts, tables, 9 × 6 in., paper, copies on application.

The purpose of this pamphlet is to present those elements of the hydraulic theory of unsteady flow in open channels that are needed in the solution of problems pertaining to the movement of flood waves in rivers, and to discuss various approximate methods that have been used for handling them. Much in the volume has not been published before or is not readily available to engineers, so it will be useful to those interested in flood control.

MODERN ACOUSTICS. By A. H. Davis. New York, Macmillan Co., 1934. 345 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $6.

Although there has not been much change in fundamental dynamical theory during the past twenty years, the subject of acoustics has undergone a considerable change. In this work, Dr. Davis reviews recent developments and describes the essentials of the subject as practiced today, for the benefit of research workers and technicians who need a knowledge of acoustical methods. Sources of sound and their theoretical relations, audio-frequency electrical apparatus, the measurement of sound intensity and frequency, sound analysis, acoustical impedance and sound transmission, sound dissipation and absorption, hearing, noise measurement and suppression, acoustics of buildings, sound recording, and reproduction are among the subjects discussed.

TECHNICS AND CIVILIZATION. By L. Mumford. New York, Harcourt, Brace & Co., 1934. 495 pp., illus., 10 × 6 in., cloth, $4.50.

An interesting, thought-provoking book, in which the author attempts to explain the origin of the machine and to trace its influence on the material prosperity and culture of Western civilization during the last millennium. While the sociological aspects of the question are emphasized, the work also has much merit as a history of technical development. Appended to the book are an interesting chronological table of inventions and a good bibliography.

THE TESTING OF BITUMINOUS MIXTURE. By D. C. Broome. London, Edward Arnold & Co.; New York, N.Y., Longmans, Green & Co., 1934. 200 pp., diagrs., tables, illus., 9 × 6 in., cloth, $5.50.

A laboratory handbook on road and building materials which deals with all accepted tests and describes the latest developments. An outstanding work in a field which suffers from lack of literature.